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The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites

Geraghty and Miller, Inc, Port Washington, N.Y.

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THE PREVALENCE OF SUBSURFACE MIGRATION
OF HAZARDOUS CHEMICAL SUBSTANCES
AT SELECTED INDUSTRIAL WASTE LAND DISPOSAL SITES

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The objective of this investigation was to establish the presence of ground-water contamination at selected industrial waste land-disposal sites. Land disposal facilities studied were lagoons and landfills and combinations of the two.

At 43 of 50 sites, migration of one or more hazardous constituents was confirmed. At four other sites, the areal extent of ground water containing hazardous substances was greater than expected, or ground water movement was not in the direction assumed during the field inspection prior to sampling. Contamination by heavy metals and/or organic chemicals was detected at these four sites. At three sites, background data was not available. Contamination with hazardous constituents was found in the monitoring wells sampled at the three sites.

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EXECUTIVE SUMMARY

Monitoring wells were sampled at 50 land disposal sites that had received large volumes of industrial wastes. The facilities include landfills, lagoons, and combinations of the two, both active and abandoned. They are located in 11 States in the humid region, east of the Mississippi River. The purpose of the investigation was to determine the prevalence of subsurface migration of hazardous chemical constituents.

The sites selected are representative of typical industrial land disposal facilities, and are situated in a wide variety of geologic environments. No previous contamination of groundwater with hazardous substances had been reported before sampling, and waste disposal had been in progress for a minimum of three years. To meet the project site selection criteria, 727 facilities were inventoried in 41 States, and regulatory agency files were examined in 23 States. From this data base, 122 sites were selected for field inspection, the purpose of which was to determine geologic and hydrologic conditions, facility design and operation, and availability of monitoring wells. About 50 percent of the inspected facilities already contained monitoring wells, and nine percent are equipped with some type of engineered ground-water protection system such as a liner. Based on the inspections, the final 50 sites to be sampled were chosen.

Ground water was considered contaminated with hazardous substances if one or more of the following constituents was detected: (1) heavy metals other than iron and manganese, (2) cy-

(5)

anide, arsenic, and selenium, (3) organic substances as determined by gas chromatography. One hundred seventy samples were collected for analysis from waste disposal sources, soil cores, springs, and wells, including 59 wells drilled at 19 sites specifically for this project.

Industrial land disposal sites are surrounded by other sources which also have the potential to add contaminants to ground water, e.g. septic tanks, leaky storage tanks and sewer lines, spills, agricultural lands receiving fertilizers and pesticides, and highway runoff. Thus, ground water free of some type of degradation is seldom present in urban, industrial, and agricultural areas. Therefore, four very strict criteria were used to evaluate whether migration of hazardous substances could be confirmed at a particular site and to determine which specific inorganic and/or organic chemicals had migrated at that site. First, one or more hazardous constituents must be detected beyond the boundary of the waste deposition area. Second, the concentration of a hazardous substance must exceed the concentration of the same substance in water from a background well or other background ground-water source. Third, all wells used to evaluate a site must tap the same aquifer. Finally, based on an interpretation of geohydrology and overall ground-water chemistry, the data must identify the landfill or lagoon under study as the source of the inorganic or organic substance.

At 43 of 50 sites, migration of one or more hazardous constituents was confirmed according to project criteria. At four other sites, although background wells had been chosen, the areal extent of ground water containing hazardous substances was greater than expected, or ground-water movement was not in the direction assumed during the field inspection prior to drilling and/or sampling. However, contamination by heavy metals and/or organic chemicals was detected at these four sites. At three sites, background data were not available because of the inability to obtain water from wells that had previously been chosen for background. Again, contamination with hazardous constituents was found in the monitoring wells sampled at the three sites.

Organic contaminants were detected at 40 of the 50 sites. Because most analyses were made by gas chromatography alone, individual organic compounds were not always identified. At 27 sites, migration of organic chemicals was confirmed according to the strict project criteria. At 13 sites, although organic compounds were detected in ground water, the landfill or lagoon under study could not be clearly identified as the source of organic contamination. Where this occurred, the site was ruled out as one at which organic substances had migrated. Using similar criteria, heavy metals, excluding iron and manganese, were found to be present at 49 sites and were confirmed to have migrated at 40 sites. Selenium, arsenic, and/or cyanide were found to be present at 37 sites, and were confirmed to have migrated at 30 sites.

In all, 86 wells and springs yielded water containing one or more hazardous substances with concentrations above background. The distance of the wells from the disposal area ranged from 3 m (10 ft) to more than 300 m (1,000 ft). Depths ranged from about 2 m (6 ft) to 49 m (160 ft).

Twelve hazardous inorganic constituents were detected above background concentrations. The five most frequently occurring were selenium, barium, cyanide, copper, and nickel in that order. Organic substances that were identified in water from monitoring wells included PCB's, chlorinated phenols, benzene and derivatives, and organic solvents.

At 26 sites, hazardous inorganic constituents in water from one or more monitoring wells exceeded the EPA drinking water limits. Of the hazardous substances, selenium most frequently exceeded drinking water limits, followed by arsenic, chromium, and lead. Halogenated pesticides, presently included in EPA drinking water standards, were analyzed for but not found.

INTRODUCTION

The fundamental objective of this investigation was to establish the presence or probable absence of ground-water contamination resulting from subsurface migration of hazardous constituents at selected industrial waste land-disposal sites. Land disposal facilities studied were lagoons and landfills and combinations of the two.

The general term "landfill" has been used in this report to describe a solid waste disposal site. EPA and many states have assigned specific definitions according to how a particular landfill is constructed and operated. Definitions for dump, landfill, and sanitary landfill are included in the attached Glossary. Landfills receive garbage, demolition debris, municipal and industrial solid wastes, sludges, and liquids. The investigation concentrated on those landfills with a major component of industrial waste.

In this report, the general term "lagoon" describes an industrial impoundment. There is no typical design for an industrial impoundment. It may be a natural or man-made depression, lined or unlined, and from a few tens of feet in diameter to hundreds of acres in size. Within the literature, the terms "lagoons," "pits," "basins," and "ponds" have been used interchangeably. The typical waste disposed of is liquid, although lagoons can also contain sludges. Landfills and lagoons, along with their potential impacts on ground-water quality, have been the subject of a number of previous EPA studies. 1-6)

"Landfill" and "lagoon" along with other terms such as "background well," "hazardous," and "toxicant," were used in descriptions of the work carried out and of the results obtained. Nomenclature does not imply, in any way, EPA statement of policy nor legal classification of a particular site or condition. Descriptive terms, including "dump" and "sanitary landfill," that appear in the site descriptions were based on those applied by the State representatives in whose company an inspection was conducted.

No site names or location maps are included in this report. Cooperation of owners and operators of waste-disposal facilities inspected and sampled was obtained with the understanding that the purpose of the study was only to compile scientific data as part of a national survey. In cases where the findings indicated possible threat to public health, all of the involved parties were immediately notified by telephone, with a subsequent written confirmation of the findings. The cooperating State regulatory agency was furnished all data for its continued follow up of the situation according to its normal procedures. In addition, if the case was deemed especially serious, the analytical laboratory was requested to contact the parties concerned to provide any supplemental information that might be desired.

Determination of whether contamination has occurred and whether migration of specific hazardous contaminants has been confirmed is based on the contractor's evaluation of the data available. Because of the complexities of geology, hydrology, and ground-water chemistry at any particular site, such data can be subject to differing interpretations, especially as new and more complete information is assembled over a longer period of time.

A Project Synopsis, dated February 24, 1977 and the Interim Project Report, dated April 15, 1977 were submitted to EPA as progress reports summarizing results of the study. The data presented in the reports were only preliminary in nature, had not undergone complete analysis, and had not received final review from the contractor, cooperating State agencies, or EPA. States were sent, for review, the preliminary site descriptions after preparation of the Interim Project Report. Their comments were considered and included in the Final Report with modifications made to accommodate those changes that were pertinent. The Final Report presents results which have been reviewed and analyzed by the contractor leading to the present set of findings and conclusions.

The original contract specified that 75 industrial waste land-disposal sites would be investigated. Due to enactment of the Resource Conservation and Recovery Act of 1976 (PL 94-580), the contract was amended to limit the number of sites to 50. This was done to allow the contractor to develop support documents for monitoring regulations required by the act. Field work that had been projected for the future in the progress reports, therefore, will not be carried out under this contract. The work includes sampling at a number of sites which have already been inspected and had been scheduled for future drilling, and filling in data gaps at several sites already sampled.

The following sections of the report contain discussions of site selection criteria and study procedures. These are followed by the site descriptions and the results of sampling. Observations with regard to monitoring are contained in the chapter entitled EVALUATION OF MONITORING TECHNIQUES. This discussion is based on inventorying data from 41 states, reviewing agency files in 23 states, and inspecting 122 sites in 15 states, including 60 with existing monitoring wells. The final chapter of the report contains the study conclusions.

Appendix A is a computer printout of the chemical analyses. Appendix B is a glossary of terms and Appendix C is a description of the quality assurance program for Penn Environmental Consultants, Inc. of Pittsburgh, Pennsylvania, the principal laboratory used in the investigation. Appendix D includes a discussion and conclusions related to land disposal of hazardous wastes. They are based on the Contractor's observations outside the scope of work.

SITE SELECTION

Criteria

Criteria were established for selecting sites to minimize bias in the set of facilities chosen for study. If one method of waste disposal, one set of geohydrologic conditions, or one type of waste were studied with disproportionate frequency, the results of the study would not be representative of the waste disposal practice as it really exists. These criteria are as follows:

No Known Damage Cases. This criterion resulted from a desire to remove any bias toward studying sites at which a positive finding of contamination would constitute simply a confirmation of previously known problems. In addition to documented damage, complaints about ground-water degradation as manifested by malodors or taste would rule out a site for consideration.

Various Geohydrologic Conditions Represented. Existing sites are located in a variety of geohydrologic environments, such as coastal plain, shallow bedrock, and flood plain. Some geohydrologic conditions more than others increase the susceptibility of ground water to contamination from activities on the land surface. Permeable coastal plain sands, for example, generally allow more rapid percolation of waste water or leachate than do silt and clay glacial tills. Ground water in limestone solution channels may move rapidly with little interaction with the formation. On the other hand, ground water in unconsolidated sediments of low permeability, may move only a few feet per

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year, and would be in virtual equilibrium with formation minerals.

A Range of Climatic Conditions Represented. Unless the wastes are liquid, precipitation greater than evapotranspiration is necessary to produce leachate. The amount and extent of movement of contaminants may be quite different under a temperate climate that allows soil to freeze for several weeks or months in comparison to a climate without extended freezing temperatures. Likewise, not only is the annual precipitation important, but also the distribution of precipitation with time. A period of intense rainfall in an otherwise warm dry climate could produce leachate from land-disposed waste.

A Variety of Disposal Methods Represented. Industrial waste is disposed of in lagoons, pits, dumps, landfills, and combinations thereof. The physical preparation of sites for the various disposal methods varies and affects the influence of wastes on the ground-water system. Lagoons or other basins for liquid impoundment, unless lined may leak and form ground-water mounds. Solid waste disposal facilities may also allow more percolate than the surrounding area and create ground-water mounds. The frequency and extent of contamination is dependent on the nature of the wastes and existing geohydrologic conditions. Chemical quality of leachate or percolate reaching the water table is a function of the rate of travel, thickness of the unsaturated zone, and geologic materials comprising the unsaturated zone.

A Variety of Industrial Wastes Represented. Wastes can consist of organic and inorganic substances, solids, liquids, and sludges. Industrial discharges include a great variety of inorganic and organic compounds, with wide ranges of solubility in water. For example, some wastes contain solid metal precipitates that are very slightly soluble, whereas the same metals may be discharged in soluble form from another process or treatment system. Removal of metals from effluents to meet discharge regulations results in production of heavy metals sludges. Organic compounds are similarly removed in effluent treatment and must be disposed of as sludges or dried solids. The intermixing of inorganic and organic wastes, wastes of high and low pH, and wastes having different physical properties in a common disposal area, may lead to influences on the environment not anticipated from any single waste material. Thus, it is important to study as wide a variety of wastes as possible.

Minimum Age of Three Years. Percolation of waste water or leachate and subsequent migration with ground water are generally slow. It may take many months for a dry solid waste to reach field capacity (the moisture content at which it transmits water) under the precipitation regime of its location. The leachate must then percolate to the water table and move with the ground water to a point outside the disposal area. A three-year period was judged to be adequate for contaminants to move far enough to be detected using the procedures of this study.

Sites, Active, Abandoned, Monitored, and Not Monitored Represented. Monitoring wells are installed at land disposal sites to meet a number of different objectives, including providing data for litigation or for defining the severity of damage to an aquifer. For this investigation, existing monitoring facilities must have been installed as a result of compliance with regulations, or because ground-water contamination was thought possible, but not as a result of known or suspected (on the basis of physical evidence) ground-water contamination. Monitored sites were studied by sampling existing monitoring wells and, in some cases, additional wells installed as part of this study. In the analysis of sampling results, the efficacy of the monitoring system was also evaluated.

Unmonitored sites were inspected, and wells were installed according to best estimates of ground-water flow direction and location of water-bearing formations. As sources of contamination, abandoned disposal sites were considered to be as significant as active sites. The wastes that are deposited continue to weather and leach for years. Moreover, containerized wastes may not begin to contaminate until several years after deposition when containers corrode and leak. At typical abandoned sites inspected during this investigation, there is no custodial care, and these sites sometimes become havens for surreptitious disposal of wastes considered so hazardous that owners of active sites are not willing or are not permitted to accept them. Under these circumstances, the potential for pollution from abandoned sites may be equal to or greater than from active ones.

Selection Process

As originally proposed, the Project Officer was to furnish a list of 100 or more monitored industrial land disposal sites, from which 50 were to be selected for study by the Contractor with the Project Officer's approval. The Project Officer was to furnish an additional list of approximately 50 candidate sites where the installation of monitoring wells would be necessary for determination of ground-water quality. Upon approval of the Project Officer, 25 of these sites were to be included in the study.

At the time the contract was negotiated, criteria for selection of study sites were developed that ruled out sites that had histories of known or suspected (on the basis of physical or chemical evidence) contamination. None of the candidate sites available to EPA or the Contractor met the criteria agreed upon at the initiation of the study. Therefore, the Contractor inventoried and inspected all of the sites finally included in the study.

Voluntary input from local and State regulatory departments and personnel was solicited from all of the continental United States. Officials in State solid waste and water resource agencies were contacted by letter and phone. They were requested to provide, at no cost to the Contractor, candidate waste disposal sites that could best meet selection criteria.

To expedite the exchange of information, forms prepared by the study team were provided the State agency personnel. Space on the form was provided for such information as age of site, type of waste received, owners name and address, type of facility, presence of monitoring wells, and probable accessibility for drilling and/or sampling. A number of States did not re-

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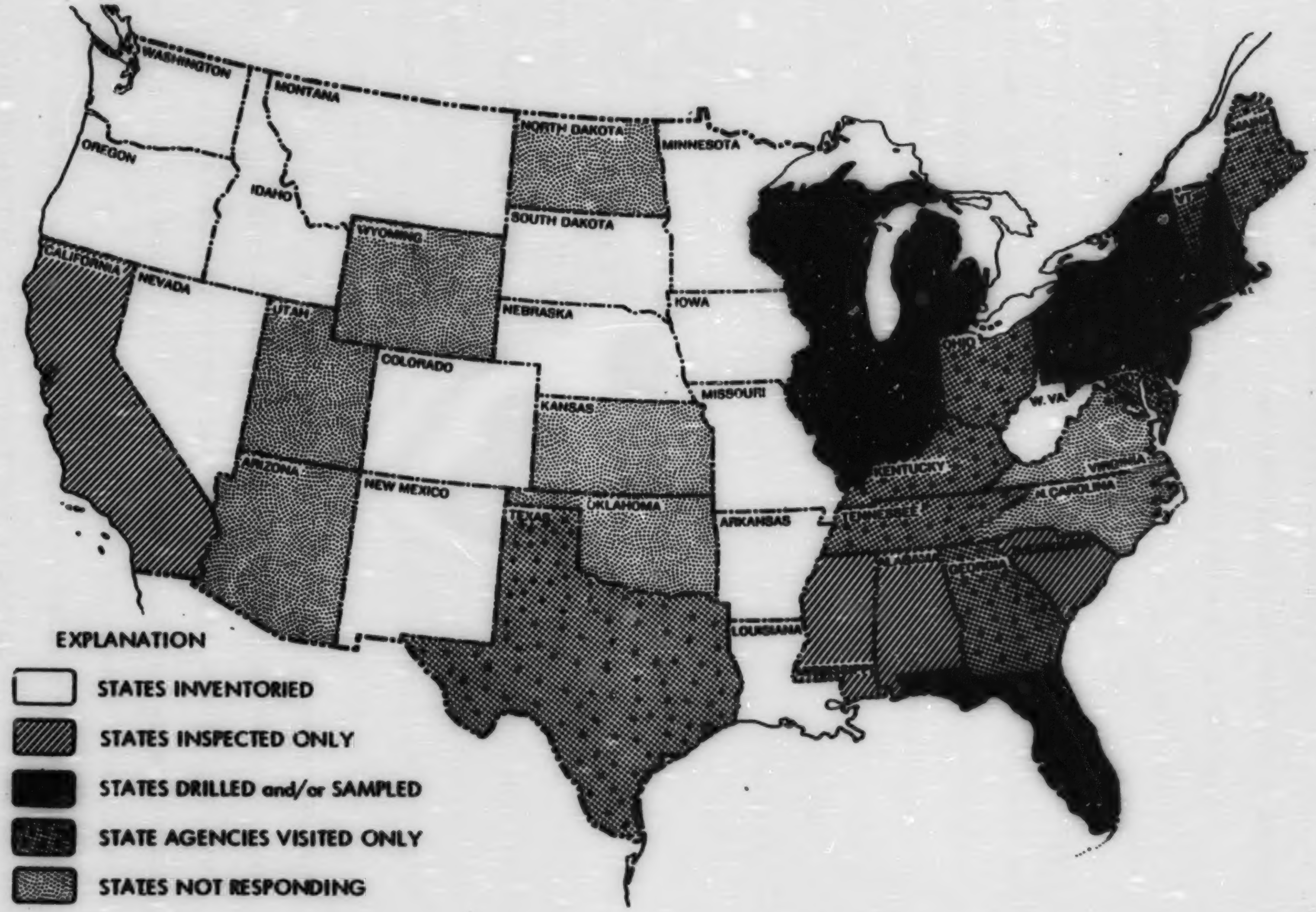
spond because the regulatory agency involved stated that it did not have the personnel available to aid in the project and the data requested were not readily available (Figure 1). Upon return of the forms, these data were tabulated with other data obtained from published sources to provide an annotated list of potential sites for inclusion in the project. Priorities were assigned to the site listings based on accessibility, geologic setting, and other of the site selection criteria.

Visits were arranged with State agencies for inspection of files pertaining to sites that appeared to be potentially useful in the study (Figure 1). State solid waste, water resource, geological survey, and health department offices were included in the visits. EPA Region I and IV offices also were visited. Inspection of regulatory agency files and conversations with agency personnel frequently turned up information on disposal sites that had not been included in the original set of data, but appeared potentially useful to the project.

A final list of potential study sites was assembled for review by the EPA Project Officer. Priorities were assigned depending on the degree to which each site met the selection criteria. Then, the process of investigating accessibility was begun, working exclusively through State agency personnel.

The final and crucial step in the selection process was that of obtaining access to the site for drilling and/or sampling. Even in cooperating States, industrial or disposal company owners refused access to a considerable number of industrial waste disposal sites. When site access was arranged, the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GEORGIA
LOUISIANA
VT
MAINE
EXPLANATION
STATES INVENTORIED
STATES INSPECTED ONLY
STATES DRILLED and/or SAMPLED
STATE AGENCIES VISITED ONLY
STATES NOT RESPONDING

Figure 1. Geographic distribution of project data base.

conditions governing it were sometimes limiting.

For example, at one site, the letter permitting access stipulated that new monitoring well locations must be within three feet of the property line. These positions were too distant from the waste deposition area to provide meaningful sampling points for detection of ground-water contamination. Permission was granted to sample existing monitoring wells on the site, but these had not been installed at locations where ground-water contamination from the disposal operation would be detected. The existing monitoring well locations exemplify the way in which a monitoring regulation can be satisfied with little possibility of useful data ever being generated.

Past experience in working with State agencies on case histories of ground-water contamination had shown that data on file did not always correspond to current conditions in the field. As a result, it was decided that the effort necessary to support an inspection of all sites appearing to fit the project criteria was justified.

For the inspection phase, arrangements were made with State regulatory personnel to accompany the Contractor to the sites given highest priority. The inspection trip was required to confirm data on location, condition and depth of monitoring wells; geologic environment; physical access to the site; and wastes actually disposed of. Locations for background water-quality sampling were also investigated. Inspection trips sometimes resulted in the opportunity to vist more suitable sites than were in the original inventory.

The inventory of sites for inspection usually was derived from data on file in the State agency's office. Once in the field, the agency representative or a local official might point out other sites actively accepting industrial wastes, but not documented with the agency. Some of these proved to be larger, more accessible, or in more suitable geohydrologic settings than those on the inventory list. Sometimes during the course of traveling, sites were observed that appeared potentially useful, and were adopted for use in the study. In some States, industrial waste sites that are located on the industry's premises are not registered with the State, so they became known only through personal knowledge of one of the State personnel or by direct observation on the inspection trips. Several of these industry-owned sites were included in the study. A total of 122 sites were inspected in 15 States. Fifty of the 122 sites were later drilled and/or sampled.

Following inspection, data obtained in the field were reviewed and plans for drilling and/or sampling were made. Where drilling was required, the inspection provided the opportunity to make an assessment of the geohydrologic conditions, and to assign locations for monitoring wells. The minimum number of sampling points per site was two, one for background and one to monitor contamination. Because of the uncertainty of locating zones of contamination, two to three monitoring wells were usually scheduled for installation. Budgetary limitations restricted well drilling to a minimum number per site, to relatively shallow depths, to unconsolidated geologic materials, and to method.

STUDY PROCEDURES

Drilling

Water well drilling was carried out at industrial waste sites that either had no monitoring wells, or where they were present, but monitoring was judged incomplete from the standpoint of this investigation. In some cases, existing wells were not located where, upon inspection by the contractor, they appeared to intercept contaminated ground water. In other instances, the existing wells appeared satisfactory, but no well was available to serve as a sampling point for background quality. At these locations, a background well was installed.

With one exception, New York Site S-5, drilling was done using the hollow-stem auger method. Major advantages are that no water is introduced into the bore hole during drilling, and PVC (polyvinyl chloride) pipe can be used for well casings because no driving of casing is employed. This method was also suitable for the relatively shallow wells (25 m or 75 ft) installed as part of this project. For most of the sites drilled, a rig mounted on a tracked vehicle was employed. It proved to be extremely useful, particularly for abandoned sites where access roads were virtually non-existent. At one site, the rig was driven down a railroad track where it drilled between ties. At New York Site S-5, a standard mud rotary rig was used in order to penetrate to a depth of 166 m (545 ft).

Drilling was done exclusively outside of the area of waste deposition to prevent contamination by surficial materials. Because the analytical schedule for chemical constituents in ground-water samples was comprehensive and included sensitive techniques for measuring heavy metals and organic compounds, contamination from drilling posed a real threat to sampling integrity. Thus, augers were cleaned and rinsed before drilling each new well.

PVC pipe was used for all well casings. It is light and easy to handle, and is more inert toward dissolved organic substances than steel casing. The iron oxide coating that develops on steel casing has an unpredictable and changeable adsorption capacity. However, once the adsorption sites on PVC are saturated, water remains in equilibrium with it. 7) Leakage of organic compounds from PVC is negligible. As a control, samples of pipe and a cemented joint were submitted to the laboratory where they were soaked in water and the water was analyzed. No contaminants were detected. A total of 59 wells were drilled at 19 sites. The wells installed were not removed by the Contractor; however, their disposition by site owners is not known.

Sampling

The laboratory chosen for performing the chemical analyses on all of the water and soil samples generated by the project was Penn Environmental Consultants, Inc., Pittsburgh, Pennsylvania (PEC). Sample containers and appropriate preservatives were furnished by the laboratory.

When the water table was within the suction limit of about 8 m (25 ft), a hand or powered centrifugal pump was used to sample the well. Enough water was withdrawn to evacuate several times the volume of the casing and to assure that water was representative of the aquifer. When pumping was impossible, wells were bailed to clean out the casing and screen, and to obtain a ground-water sample. The bailers were constructed of PVC pipe, plugged at one end, in lengths of 30 and 61 cm (12 and 24 in.). PVC-coated lead weights were used to offset the buoyancy of the plastic and the displacement of water. The small (3.8-cm or 1.5-in.) diameter well casings could be evacuated with only a few bailer volumes of water.

The laboratory supplied six containers with appropriate preservatives for each water sample, requiring a total volume of about 8 litres (2 gal.). This volume of water equaled several bailer volumes. Four wells did not yield at a high enough rate to allow a complete sampling. In each case the constituents considered most important were noted for the laboratory.

Frequently the wells could not be surged and pumped for a long enough period to yield water free of turbidity. Filtration was, therefore, required in addition to the membrane filtration routinely done for the samples for metal analysis. In the worst cases, water was gravity filtered through a filter paper in a conical funnel, followed by suction filtration through finer-pore paper in a Buchner suction funnel, and finally suction filtered through fiberglass prefilters and a 0.45 micrometre pore-sized membrane. 8) Filtration proved difficult to accomplish in the field. A few samples that contained large quantities of clay or fine silt-sized particles were impossible to handle without an electric vacuum pump. These samples were shipped to the laboratory without preservatives. It was assumed that preservatives would change the chemical equilibrium between the dissolved and suspended substances more than would the time required for shipment.

Particular care was taken in cleaning bailers, pumps, and filtration apparatus after collection of each sample. The sensitivity of analytical methods and comprehensiveness of the analyses dictated that cross contamination be avoided. All apparatus was washed and rinsed with deionized or distilled water. As previously mentioned, the augers used in drilling were also cleaned as thoroughly as possible.

Soil samples were collected with a split-spoon sampler. This is a steel tube that, as driven into the ground. becomes filled with soil. Upon recovery, retaining rings are removed and half of the tube is removed, exposing the soil core. With a hollow stem auger, the sampler can be driven ahead of the auger, allowing samples to be taken continuously or at preset intervals. Soil samples were sent to the laboratory in polyethylene bottles.

Chemical Analysis

Commercial analytical chemical laboratories were investigated in regard to capabilities for performing both inorganic and organic analyses on water samples. Six laboratories were visited as part of the selection process. Initially, no decision had been made with regard to the issue of one or several laboratories to handle the analyses. The large distances between study sites suggested a regional approach to the choice of laboratories. However, the administration of sampling, and the necessity for comparison of results, made the use of one laboratory more appealing. Because the water samples were not being analyzed for the most time-sensitive parameters (BOD, biological specimens, or forms of nitrogen), one laboratory, PEC, was selected.

The analytical schedule adopted included emission spectrographic analysis for 30 or more metals to provide a scan that would detect unusual metals which might otherwise be overlooked. The emission results were used as the basis for quantifying up to six metals by atomic absorption spectroscopy. Either the metals with highest concentrations or those on a list of priorities (general or site specific) were chosen from the group: barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, molybdenum, nickel, tin, vanadium, and zinc.

Wet chemical methods were used for selenium, arsenic, mercury, cyanide, fluoride, hexavalent chromium and phenol. A group of constituents comprising those included in a "standard" water analysis was used for only some of the water samples. To interpret the location and characteristics of contamination, constituents that are not considered hazardous, but are generally used for characterizing water quality, were included in the analysis. This group was comprised of calcium, magnesium, sodium, potassium, chloride, sulfate, and phosphate. Sodium, calcium, chloride, and sometimes sulfate, are found in elevated concentrations in landfill leachate. For exclusively industrial waste disposal sites those components would have to be included in the wastes in order to become ground-water contaminants. However, if found along with hazardous constituents in elevated concentrations, these constituents add further evidence that contamination has occurred.

Three gas chromatographic scans were arranged to detect polychlorinated biphenyls (PCB's) and related compounds, halogenated pesticides (aldrin, dieldrin, etc.), and volatile organic compounds (ketones, alcohols, hydrocarbons, etc.). The detection limit for most of the organic compounds was 0.001 milligram/litre (mg/l). Organic compounds can be identified either through the use of standards in the gas chromatograph or by use of a mass spectrometer. The latter splits up organic molecules after they have been separated in a gas chromatograph and records the masses and abundances of the molecular fragments. The original compounds can then be determined through interpreting the mass spectrum.

For the purposes of this study, organic chemical migration was defined as the presence of organic compounds in concentrations above background. Identification of the compounds themselves was not required; therefore only the gas chromatographic analysis was prescribed. The use of the mass spectrometer would have doubled the cost of analysis with questionable justification.

Soil samples were extracted with dilute acid for metal analysis and with organic solvents for organic analysis. Metals were determined on the extracts by emission spectroscopy and atomic absorption spectrophotometry. Cyanide, phenols, and fluoride were determined by wet chemical techniques.

The chemical equilibrium of ground water is usually disturbed when it is withdrawn from an aquifer. Exposure to the atmosphere may drastically change the dissolved gas complement, resulting in changes in pH and dissolved oxygen. Thus, in order to measure characteristics of ground water as they were in the aquifer, the measurements must be made immediately upon withdrawal of the water. Specific conductance, pH, and dissolved oxygen were, therefore, measured in the field.

Ground water was considered to be contaminated with hazardous substances if one or more of the following constituents was detected: (1) heavy metals other than iron and manganese, (2) cyanide, arsenic, or selenium, (3) organic substances as determined by gas chromatography. The results of sampling and the evaluation of migration of hazardous substances is presented in the next section of this report.

Cyanide is listed in the hazardous category because it was included in previous Federal drinking water standards and is retained in many State standards. Cyanide is highly toxic to fish and may enter surface water with ground-water discharge. An additional consideration is that private ground-water potable supplies are not treated, nor are some public ground-water supplies. Thus chlorination would not detoxify cyanide migrating in leachate.

Results of 170 chemical analyses have been computerized for future access and statistical analysis (Appendix A). Where requested, results were sent to cooperating State agencies and EPA regional offices. Water-quality data from wells determined to be contaminated were compared to drinking water standards promulgated or proposed by EPA (Table 1). 9,10) Comparisons were based on "hazardous" components (heavy metals--except iron and manganese, arsenic, selenium, and listed organic pesticides). As mentioned previously, when there appeared to be a threat to the owner of a water supply well used for monitoring because of the identification of a potential toxicant in the water, the user was contacted by the contractor or the proper State agency.

TABLE 1

PERTINENT CONSTITUENTS FROM THE NATIONAL INTERIM PRIMARY AND SECONDARY DRINKING WATER REGULATIONS[9,10]

Primary		Secondary	
Constituent	Concentration (mg/l)	Constituent	Concentration (mg/l)
Arsenic (As)	0.05	Chloride	250
Barium (Ba)	1.0	Copper (Cu)	1
Cadmium (Cd)	0.010	Iron (Fe)	0.3
Chromium (Cr)	0.05	Manganese	0.05
Lead (Pb)	0.05	Sulfate (SO_4)	250
Mercury (Hg)	0.002	Zinc (Zn)	5
Nitrate as N	10		
Selenium (Se)	0.01		
Silver (Ag)	0.05		
Fluoride (depends on avg. air temperature)	1.4 to 2.4		
Endrin	0.0002		
Lindane	0.004		
Methoxychlor	0.1		
Toxaphene	0.005		
2,4-D	0.1		
2,4,5-TP Silvex	0.01		

PRESENTATION OF DATA

A total of 23 States were visited for the purposes of gathering data on industrial waste land disposal sites (Figure 1). The combination of correspondence and State visits resulted in an inventory of 727 industrial waste land disposal facilities. The inventory data included geohydrologic, site engineering, site monitoring, and availability of water quality information for each site. The amount of information available for sites varied from site to site and State to State. The data were reviewed in detail to provide a list of sites with high priority for inclusion in the project.

Because existing ground-water monitoring facilities could be utilized for the project, information about them was of particular interest. Of the inventoried sites, 35 percent had ground-water monitoring facilities. The water quality data collected from monitoring of waste sites varied between States. Some States required only a limited number of non-hazardous constituents, whereas others included, at least initially, comprehensive chemical analyses including heavy metals. Monitoring data for organic chemicals was virtually nonexistent.

An evaluation of inventory data showed that the information on file with State agencies was not detailed enough to select facilities suitable for inclusion in this study without conducting on-site inspections. Thus, inspections were carried out in 15 States, all but one of which lie east of the Mississippi River (Figure 2). The number of site inspections ranged from one to 17 per State.

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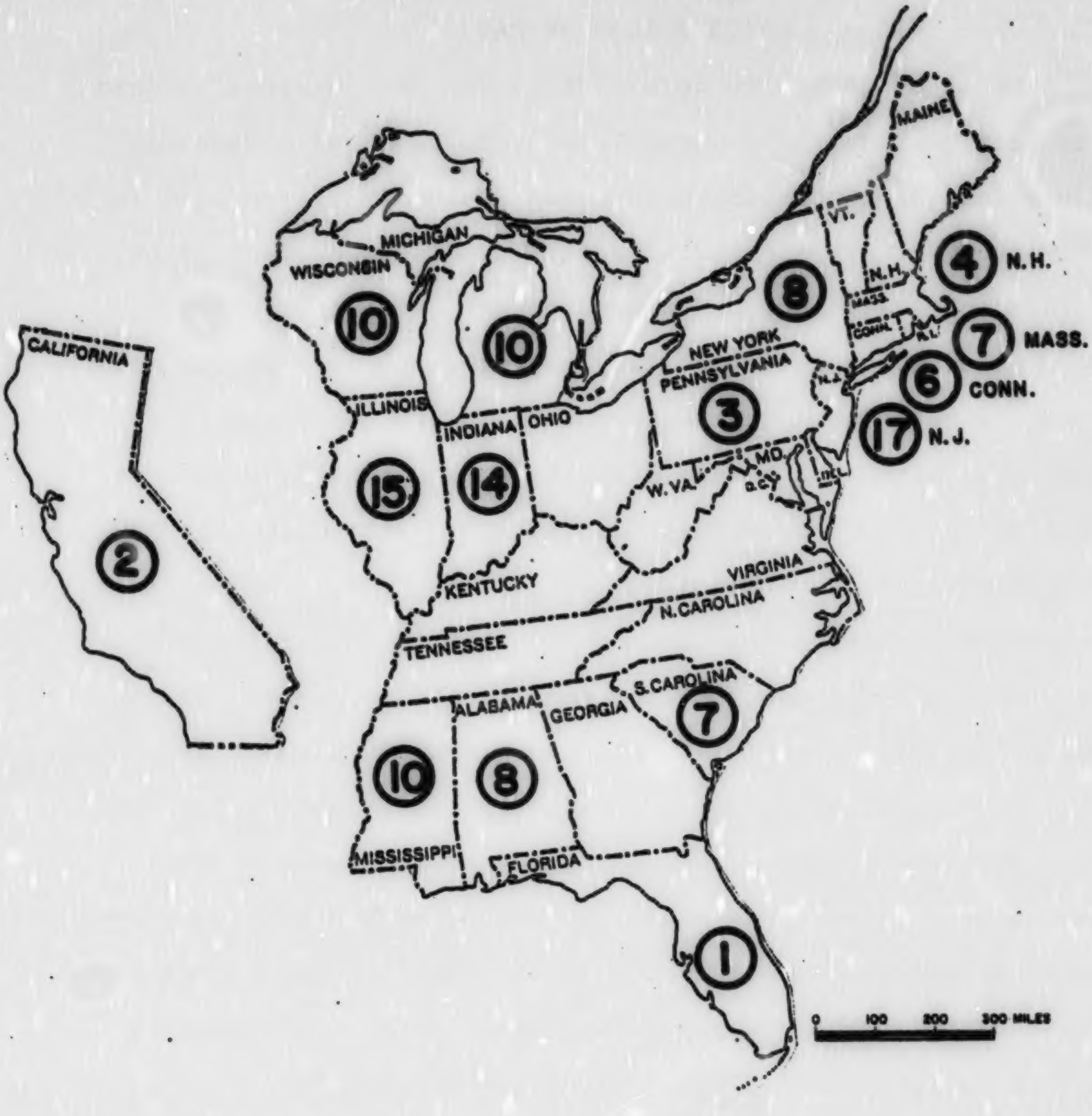
CALIFORNIA
2
WISCONSIN
10
MICHIGAN
10
ILLINOIS
15
INDIANA
14
OHIO
KENTUCKY
TENNESSEE
MISSISSIPPI
10
ALABAMA
8
GEORGIA
FLORIDA
1
S.CAROLINA
7
N.CAROLINA
VIRGINIA
W.VA.
MD.
D.C.
PENNSYLVANIA
3
NEW YORK
8
VT.
N.H.
MASS.
CONN.
R.I.
MAINE
4
N.H.
7
MASS.
6
CONN.
17
N.J.
0
100
200
300 MILES

Figure 2. Total number of sites inspected in each of the 15 states.

Data gathered during inspection were reviewed, and a final list was compiled of sites that fit the study criteria and were accessible to the contractor. These sites were distributed through 14 states, but sampling was carried out in only 11 states (Figure 3). Sites had been scheduled for drilling and sampling in Mississippi, Alabama, and South Carolina; however, the contract was amended in April 1977 limiting the sampling to 50 sites.

The number and geologic setting of industrial waste land disposal sites inventoried, inspected, and sampled is summarized for each of the 15 states below.

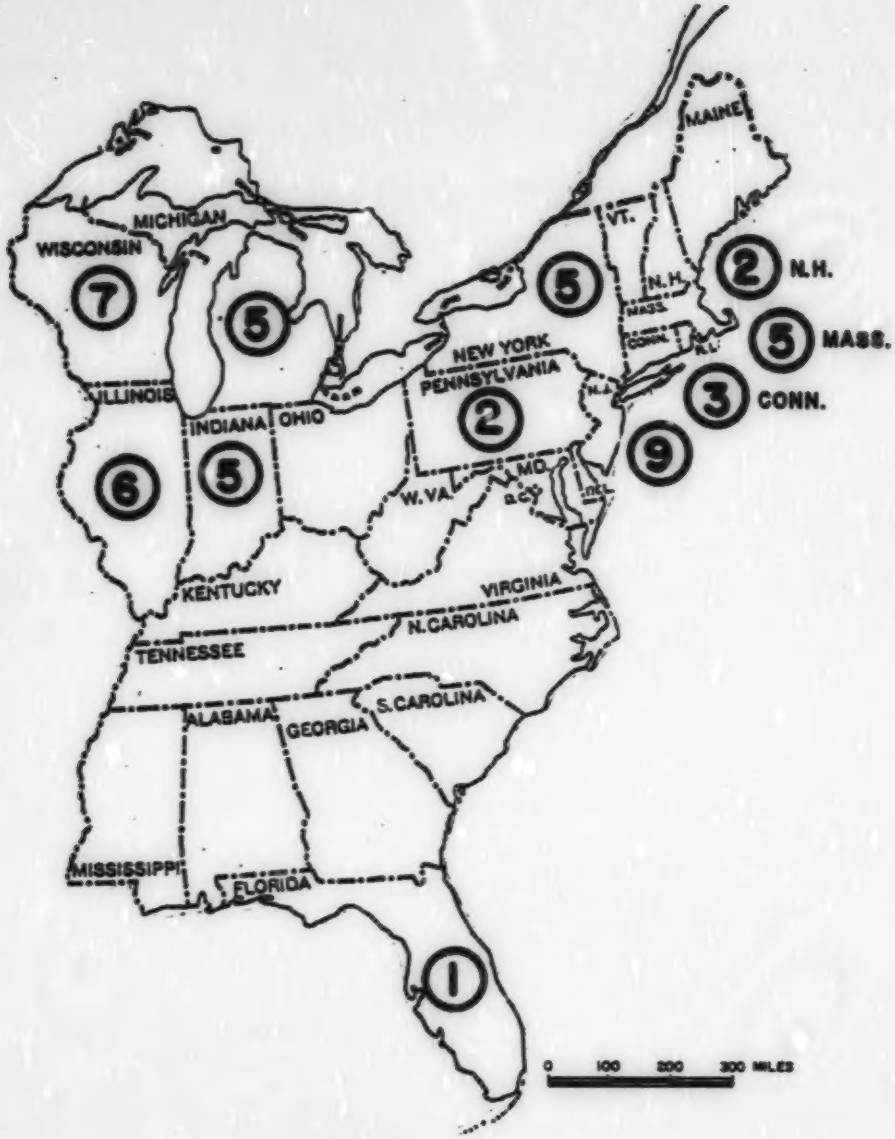
MAINE
VT.
N.H.
MASS.
CONN.
R.I.
2
N.H.
5
MASS.
3
CONN.
9
N.J.
5
NEW YORK
PENNSYLVANIA
2
MICHIGAN
WISCONSIN
7
5
ILLINOIS
INDIANA
OHIO
6
5
W. VA.
MD.
D.C.
DEL.
KENTUCKY
VIRGINIA
N. CAROLINA
TENNESSEE
S. CAROLINA
ALABAMA
GEORGIA
MISSISSIPPI
FLORIDA
1
0
100
200
300 MILES

Figure 3. Total number of sites sampled in each of the 11 states.

State Summaries

Alabama. Eight industrial waste disposal sites were inventoried and field inspected in Alabama in July 1976. They are distributed throughout the state in all of the primary climatic and geohydrologic environments. The four sites in the northern half of the state are generally situated in geologic provinces characterized by formations of low permeability. This favorable geologic setting would tend to minimize the chances of appreciable ground-water contamination occurrences. The four sites in southern Alabama are underlain by sandy earth materials, which normally permit contamination from surface sources to readily enter and migrate significant distances through shallow aquifers. The average yearly precipitation ranges from about 135 cm (53 in.) at the northernmost site to approximately 163 cm (64 in.) at the southernmost. All eight sites were scheduled for detailed study and sampling during the spring of 1977, but this could not be accomplished because of early project termination.

California. All of the California Regional Water Quality Control Boards were contacted and requested to provide pertinent information about hazardous waste disposal sites in their respective jurisdictions. Information on 12 sites was furnished, and inspections were conducted in February 1977 at two locations both of which have been designated under the California system as Class I. The two sites are located in the San Francisco area. Further work in California was scheduled for the summer of 1977 but was not carried out because of the early project termination.

Connecticut. Fifteen industrial waste disposal sites were inventoried in Connecticut. Of this total, six sites were chosen for field inspection, three of which were selected for drilling and sampling. These are situated in different geohydrologic environments: coastal zone, glaciated upland, and river flood plain. The average yearly precipitation ranges from about 112 cm (44 in.) at the easternmost site to 122 cm (48 in.) at the westernmost site.

Florida. Six waste disposal sites that accept industrial wastes were inventoried in Florida. Of those, only one had reliable records of hazardous waste and was accessible to Geraghty & Miller, Inc. personnel for study. A structural failure of this lagoon-type facility occurred in 1976 allowing oily wastes to contaminate a creek. A subsequent EPA investigation of the spill discovered PCB's as components of the contamination. A concern for ground-water contamination was expressed, and it was requested by the EPA regional office that this site be included in the project. Sampling was carried out in September 1976.

Illinois. A total of 70 industrial waste disposal sites were inventoried in Illinois. Of these, 15 sites were selected for field inspection, which was conducted in July and September 1976. Six of the sites inspected were chosen for further study; five were sampled in December 1976 and one in March

1977. Sampled sites are distributed throughout the state in the primary geohydrologic and climatic environments. Geologic conditions at the sites studied vary from thick clay till overlying carbonate bedrock to sand and gravel deposits adjacent to streams. The average yearly precipitation ranges from 81 cm (32 in.) at the northernmost site to 97 cm (38 in.) at the southernmost.

Indiana. The number of industrial waste disposal sites inventoried in Indiana totaled 64. Data on only 30 of these sites were adequate to consider them for inspection. Of the 30, 14 were chosen and inspected in August 1976. Five sites were chosen for additional study, and were sampled during November 1976. All sites were located in the glaciated region of the state. Two sites were located in glacial sand, one in glacial clay, and two in shallow carbonate bedrock environments. The average annual precipitation in the vicinities of the sites ranges from 97 cm (38 in.) to 107 cm (42 in.).

Massachusetts. Seven hazardous waste disposal sites were inspected in Massachusetts. Of this total, five sites were sampled in November 1976. Three of the five sampled sites were situated on flood plain and glacio-lacustrine deposits. Because of the widespread occurrence of fine-grained deposits, difficulty was sometimes encountered in locating sediment capable of yielding the quantity of water necessary for sampling. The average yearly precipitation ranges from 112 cm (44 in.) at the northernmost site to 102 cm (40 in.) at the southernmost.

Michigan. A total of 51 waste disposal sites were inventoried. Of these, 10 sites were selected for field inspection, which was conducted in August 1976. Five of the sites were chosen for sampling, and this was accomplished in November 1976. The sampled sites were distributed throughout the Lower Peninsula; none were located on the Upper Peninsula. All of the sampled sites are underlain by glacial drift. The average yearly precipitation ranges from about 71 cm (28 in.) in the north to 91 cm (36 in.) in the southwest region of the Lower Peninsula.

Mississippi. Twelve land disposal sites that reportedly had received industrial waste were inventoried; ten of these were field inspected in July 1976. Of the sites inspected, four met project criteria. All are situated upon sandy and sandy clay deposits. The sites were equally distributed from north to south throughout the state, where the yearly precipitation ranges from 132 cm (52 in.) to 152 cm (60 in.) respectively. Subsequent sampling of these sites was not done due to early termination of the project.

New Hampshire. Thirty-five industrial waste land disposal sites were inventoried in New Hampshire. Of this total, four sites were selected for field inspection, which was conducted during the fall of 1976. Two of these sites were chosen for drilling and sampling in November 1976. One site was located on the flood plain of a river and the other was in a tidal wetland. The average annual precipitation in the study area is 147 cm (58 in.).

New Jersey. A total of 41 sites was inventoried in New Jersey. Of these, 17 were inspected, nine of which were drilled and/or sampled. The first site was drilled and sampled in July 1976. The remainder were drilled and/or sampled between August 1976 and February 1977. The sites were generally located in the coastal plain region of the state, ranging from a few miles south of the New York metropolitan area to the southern tip of the state, and westward to the Pennsylvania border. The yearly precipitation averages 112 cm (44 in.).

New York. A total of 23 industrial waste disposal sites were inventoried in New York. Of these, eight sites were field inspected in October 1976. Five of the inspected sites were subsequently sampled in November and December 1976 and in January 1977: three in the northern glaciated region, one in the Hudson River Valley, and one in the coastal plain. The average yearly precipitation ranges from about 102 cm (40 in.) at the northernmost site to 114 cm (45 in.) at the southernmost.

Pennsylvania. Thirty-five industrial waste disposal sites were inventoried in Pennsylvania. Of this total, three sites were selected for field inspection, which was conducted in late September 1976. Two of the three sites inspected were subsequently chosen for further study and were sampled in December 1976. One site is underlain by metamorphic rock and the other by carbonate rock. The average yearly precipitation in the vicinity of the sites is about 102 cm (40 in.).

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South Carolina. Ten industrial waste disposal sites were inventoried in South Carolina. Seven of these were field inspected in June and July 1976. Three of the inspected sites are situated in the eastern and central two-thirds of the state where coastal plain deposits of permeable unconsolidated earth materials prevail. The other four sites are in the western part of the state and are generally underlain at shallow depth with dense igneous and metamorphic rock formations capped by a thin mantle of fairly impermeable clayey soils. Average yearly precipitation ranges from 137 cm (54 in.) to 122 cm (48 in.) in the vicinity of the sites inspected. Four sites that best fit the site selection criteria were scheduled for sampling in 1977. However, no further work was conducted because of early project termination.

Wisconsin. A total of 47 sites were inventoried in Wisconsin during May 1976. Nine of the sites inventoried, and an additional one, were field inspected between August and September 1976. Seven of the inspected sites were sampled in October 1976: four sites are in glaciated areas, two on flood plains, and one was located over shallow bedrock. The average yearly precipitation ranges from 71 cm (28 in.) at the westernmost site to 81 cm (32 in.) at the easternmost.

Descriptions of Sites Drilled and/or Sampled

Disposal sites in States ranging from New Hampshire to Florida and west to the Mississippi River were sampled using existing ground-water monitoring facilities or by drilling monitoring wells (Table 2). In carrying out the investigation, every attempt was made to obtain a cross section of typical practices presently in use for land disposal of industrial wastes. Fifty-nine monitoring wells were installed as part of this study, at 19 sites.

Site location in respect to geologic environment was an important factor in relating the waste disposal practice to ground-water contamination. The geological settings of sampled sites were shallow bedrock 12 percent, flood plain 16 percent, coastal plain 18 percent, and glaciated 54 percent. Of these, only 20 percent of the facilities were located in areas where the underlying sediments could be classified as being of low permeability. At the other extreme, 16 percent of the facilities were located in abandoned sand pits or quarries. Sites chosen for sampling were distributed throughout the climatic regions and geological provinces of each State to the greatest degree possible.

A variety of waste materials and facility types were included among the sampled sites. Solids, liquids, and sludges of organic and inorganic composition are included. Lagoons, landfills, and combinations of the two comprise the facility types. Thirty-two sites had existing monitoring wells. Only four facilities had engineered leachate control systems such as liners and collectors or recirculating systems. The disposal

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TABLE 2

SUMMARY OF DATA FROM SITES DRILLED AND/OR SAMPLED

State and site		Location in state	Geologic setting	Age (yrs)	Facility type	Reported waste types received	Moni-tored	Active
Connecticut	S-1	SW	Glaciated area - sand	>10	Landfill	Organic solids & liquids		✓
	S-2	EC	Flood plain	>10	Lagoon	Organic & inorganic liquids	✓	✓
	S-3	W	Glaciated area - clay	40+	Combination	Organic liquids		✓
Florida	S-1	NE	Shallow bedrock - carbonate	>10	Lagoon	Organic & inorganic liquids	✓	
Illinois	S-1	EC	Glaciated area - clay	>30	Landfill	Organic & inorganic solids & liquids	✓	✓
	S-2	NE	Glaciated area - clay	4	Landfill & lagoon	Organic & inorganic solids & liquids	✓	✓
	S-3	NW	Glaciated area - clay	4	Landfill	Organic & inorganic solids & liquids	✓	✓
	S-4	NC	Glaciated area - sand	3	Landfill* †	Organic & inorganic solids & liquids	✓	✓
	S-5	NE	Glaciated area - clay	12	Landfill†	Organic & inorganic solids & liquids	✓	✓
	S-6	SW	Flood plain	11	Landfill	Organic & inorganic solids & liquids	✓	✓
Indiana	S-1	SW	Shallow bedrock - limestone	?	Lagoon	Organic liquids		✓
	S-2	NW	Glaciated area - sand	3	Landfill & lagoon	Organic & inorganic liquids*	✓	✓
	S-3	SW	Glaciated area - sand	?	Landfill	Organic liquids		✓
	S-4	SW	Shallow bedrock - limestone	>15	Landfill	Organic liquids		
	S-5	NE	Glaciated area - clay	7	Landfill	Organic & inorganic solids & liquids	✓	✓
Massachusetts	S-1	NC	Flood plain	25	Landfill*	Organic liquids & solids		✓
	S-2	NC	Glaciated area - sand	6	Landfill & lagoon	Inorganic liquids & organic solids		✓
	S-3	SW	Glaciated area - clay	50	Landfill	Organic liquids & solids	✓	✓
	S-4	W	Flood plain	24	Landfill*	Organic solids		✓
	S-5	SC	Flood plain	5	Landfill	Unknown		✓
Michigan	S-1	SW	Glaciated area - sand	18	Lagoon	Inorganic liquids	✓	✓
	S-2	SE	Glaciated area - sand	21	Lagoon	Inorganic liquids		✓
	S-3	NC	Glaciated area - sand	17	Lagoon	Inorganic liquids	✓	✓
	S-4	WC	Glaciated area - sand	>20	Lagoon	Inorganic liquids	✓	✓
	S-5	WC	Glaciated area - sand	>20	Lagoon	Inorganic liquids	✓	✓
New Hampshire	S-1	SE	Glaciated area - sand	15	Landfill*	Organic & inorganic solids and liquids		✓
	S-2	S	Glaciated area - sand	7	Landfill	Inorganic liquids & solids & organic liquids		✓

TABLE 2 (Continued)

State and site		Location in state	Geologic setting	Age (yrs)	Facility type	Reported waste types received	Moni-tored	Active
New Jersey	S-1	SE	Coastal plain - sand	>10	Landfill	Organic liquids	✓	
	S-2	SW	Flood plain	>10	Landfill	Unknown		✓
	S-3	EC	Coastal plain - sand	>10	Landfill &	Unknown		
	S-4	SC	Coastal plain - sand	<10	Lagoon	Inorganic liquids		
	S-5	SW	Coastal plain - sand	>10	Landfill†	Organic sludge & inorganic solids	✓	✓
	S-6	SW	Coastal plain - sand	<10	Landfill	Unknown	✓	
	S-7	SE	Coastal plain - sand	>10	Lagoon	Unknown	✓	✓
	S-8	SE	Coastal plain - sand	>10	Landfill	Unknown	✓	✓
	S-9	SW	Coastal plain - sand	>10	Landfill & lagoon	Organic liquids	✓	✓
New York	S-1	NE	Glaciated area - clay	22	Landfill*	Organic liquids & solids		
	S-2	NC	Glaciated area - clay	6	Landfill	Organic liquids & inorganic solids	✓	✓
	S-3	NE	Glaciated area - sand	16	Landfill*	Organic liquids & solids		✓
	S-4	SE	Glaciated area - sand	3	Landfill*	Organic & inorganic sludge	✓	✓*
	S-5	SE	Coastal plain - sand	40+	Landfill & lagoon*	Organic & inorganic liquids		✓
Pennsylvania	S-1	SE	Shallow bedrock - crystalline	7	Landfill	Organic solids	✓	✓
	S-2	SE	Shallow bedrock - shale	15+	Landfill†	Organic & inorganic solids	✓	✓
Wisconsin	S-1	EC	Glaciated area - clay	7	Lagoon	Inorganic sludges	✓	✓
	S-2	SC	Glaciated area - sand	4	Landfill & lagoon	Organic & inorganic sludges*	✓	✓
	S-3	EC	Flood plain	26	Landfill & lagoon	Inorganic solids & sludges	✓	✓
	S-4	SE	Glaciated area - clay	5	Landfill	Organic liquids	✓	✓
	S-5	EC	Flood plain	26	Landfill	Inorganic sludges & liquids	✓	✓
	S-6	SE	Glaciated area - clay	9	Landfill	Organic & inorganic solids & liquids	✓	✓
	S-7	WC	Shallow bedrock - sandstone	7	Landfill	Inorganic solids	✓	

* Facility located in abandoned sand and gravel or limestone quarry.

† Facility engineered with some type of leachate control such as liner, underdrain, or recirculation.

facilities range in age from 3 to 50 years.

Abandoned facilities were included because they do not cease to be sources of ground-water contamination just because they have been closed. In fact, at some abandoned sites, surreptitious disposal of wastes not acceptable at active facilities was noted. There were seven abandoned facilities included among sampled sites.

The site descriptions presented below briefly describe the facility, its geologic setting, and the chemical quality of the ground water sampled in its vicinity. The complete chemical data for all sites are presented in Appendix A. Results of sampling are presented in the following section of this report.

Connecticut

Site CT S-1. The site is situated on the southwestern Connecticut shore in an estuarine environment and consists of a 12 ha (30 acre) landfill. The landfill is active and receives a variety of industrial and municipal wastes with a record of large amounts of PCB's.

Site geology, furnished by a recent engineering study complete with borehole data, indicates the presence of medium to coarse glacial outwash sands with minor clay lenses, generally less than 15 m (50 ft) thick, resting atop dense crystalline metamorphic bedrock (gneiss). Under such geologic conditions, migration of generated leachate is expected. Discharge of ground water probably occurs into salt-water bodies which lie less than 150 m (500 ft) away on either side of the landfill. In October 1976, ground water was measured at depths of less than 2.5 m (8 ft) below ground surface in three wells driven within 61 m (200 ft) and downgradient from the landfill. A background well (Well 4) was installed approximately 460 m (1,500 ft) to the southwest. Samples were obtained from Wells 1, 2, and 4. No sample was obtained from Well 3, which hit an obstruction and was abandoned.

Well 1 produced a water sample with a strong organic odor and a slightly green color. Upon exposure to air, iron precipitated from solution and an odor of hydrogen sulfide was noted. Chromium 0.02, selenium 0.02, and barium 0.1 mg/l were present, but not above background concentrations. Well 2 yielded water with noticeable odor, and, upon atmospheric exposure, iron precipitated. Cyanide 0.005, barium 0.2, and arsenic 0.04 mg/l were present above background concentrations. Light volatile organic compounds were also detected.

The background well produced water of seawater salinity and with a number of heavy metals. The location of the well virtually precluded contamination from leachate. Surveys by the National Oceanic and Atmospheric Administration (NOAA) of the New York bight and Long Island, New York, bays have reported concentrations of heavy metals in sediments greatly exceeding concentrations in water, and even in sewage sludge for some elements.11) Similar heavy metal contamination may be contributing to the water withdrawn from Well 4. The presence of high iron and manganese concentrations in Wells 1 and 2 in comparison to Well 4 suggests that they are affected by landfill leachate.

Site CT S-2. The site, in east-central Connecticut, is privately owned and occupies part of a meander of a moderately-sized river. Dry demolition fill (concrete, tree stumps, etc.) municipal trash, and industrial wastes are accepted. The industrial wastes, mainly organic solvents, have been received for at least 25 years.

Geology consists of flood-plain sediments (sands and silts) about 5 m (16 ft) thick over glacial till of undetermined thickness. Unconsolidated deposits are reported to be a maximum of 30 m (100 ft) in thickness over crystalline bedrock (gneiss). Ground-water movement from the liquid impoundment is toward the river, which bounds the lagoon on three sides. Water levels within the lagoon were about 5 m (16 ft) higher than the river level at the time of inspection (September 1976).

Five monitoring wells were drilled in September 1976, around the outside of the fill dike. They were 5 to 6 m (15-20 ft) in depth, with water levels between 2 and 4 m (6 and 12 ft) below grade. These encountered mostly fine silty sands.

A water sample taken from the lagoon was less heavily contaminated because of rain-water dilution than samples taken from the monitoring wells. Ground-water samples were noticeably contaminated with organic substances. Halogenated compounds, PCB's or similar compounds, were detected, but in less than 0.001 mg/l concentrations. However, volatile organic compounds were detected at concentrations up to 1,000 mg/l in the ground water. A number of common ketones and alcohols used as industrial solvents are discarded in the lagoon. Copper (0.12 mg/l), nickel (0.11 mg/l), mercury (0.0006 mg/l), selenium (0.41 mg/l), and cyanide (0.02 mg/l) were detected in one or more of the ground-water samples. Background analyses were obtained from a nearby fish hatchery where production wells are finished in the same water-bearing formation. Background water quality does not indicate contamination, based on available analyses.

Site CT S-3. This western Connecticut site has been operating since the 1930's and receives a wide variety of municipal and industrial wastes. It consists of a roughly circular 16 ha by 15 m (40 acre by 50 ft) high landfill mound. A circular lagoon, 10 to 12 m (35-40 ft) in diameter at the mound apex, appears to receive large volumes of liquid wastes and sludges.

Local topography is quite hilly with narrow valleys characteristically occupied by streams, ponds, and wetlands. The landfill is located on a wetland encircled by small streams and ponds. Nearby locations are characterized by glacial till overburden atop dense metamorphic bedrock, both of low permeability, with occasional sand and gravel stream channel deposits of high permeability. The unconsolidated deposits are generally quite thin, with bedrock surfaces being the major controlling factor in both ground-water and surface-water flow.

Monitoring Wells 1 and 2, located at the wetland site perimeter about 91 m (300 ft) east of the fill mound and Well 3 designated as background, southwest of the site, were installed in October 1976. Depths of Wells 1, 2, and 3 are 1.8 m (6 ft), 5.2 m (17 ft), and 3.8 m (12.5 ft) respectively, with Well 3 positioned close to the foot of a hilly area which rises about 91 m (300 ft) higher than that of the valley in which the landfill is located. Ground water was encountered between depths of from 2 to 3 m (6-9 ft) below land surface.

Well 1 yielded odorous water containing chromium (0.01 mg/l) and cyanide (0.007 mg/l). Well 2 bailed dry, did not recover during the day's operation, and was not sampled. Well 3 yielded water easily and a clear sample without detectable odor was collected, in contrast to the strong leachate odor noted in the sample from Well 1. Chromium and cyanide found in Well 1 were not detectable in the background water sample. Neither of the ground-water samples showed organic contamination.

Florida

Site FL S-1. The site is located in northeastern Florida and consists of seven waste lagoons. Acid sludge and waste clay from oil rerefining were disposed of in the lagoons for an indeterminate length of time. The lagoons were abandoned about 15 years ago.

As a part of the project, four wells were installed adjacent to the lagoons in September 1976. Split-spoon samples were taken every 1.5 m (5 ft) to a 15 m (50 ft) depth, and every 3 m (10 ft) to a final depth of 37 m (120 ft) in the first well constructed. These samples showed fine to very fine sand containing varying amounts of silt, clay, and shell fragments to a depth of 26 m (84 ft) and a silty clay containing traces of very fine sand and shells to a depth of 37 m (120 ft). A thin bed of weathered coquina was encountered at a depth of 4.3 m (14 ft). The other three wells were completed to depths of 9, 18, and 24 m (30, 60, and 80 ft), respectively.

Because of the nature of the contamination, shallow and deep core samples were chosen for analysis. Relatively high concentrations of chromium, copper, lead, and vanadium (4.8, 1.1, 8.0, and 13 mg/l respectively) were detected in the shallow sample. Chromium, copper, and lead were also present at lower concentrations in the deeper core sample. Heavy volatile organic compounds were present in both the shallow and deep cores (5,800 and 300 mg/l respectively), but PCB-type compounds (0.005 mg/l) were detected only in the deeper one.

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Water samples collected from the three monitoring wells contained halogenated compounds not corresponding to pesticides or PCB standards. Barium (0.1 mg/l) and selenium (0.02 mg/l) were the only toxic metals detected in these water samples. All of the wells installed proved to be within the zone of contamination. A nearby residential well was used for background monitoring, and the water obtained showed no contamination.

Illinois

Site IL S-1. The site is located in east-central Illinois, and consists of a 28-ha (70-acre) landfill. Wastes from chemical and biological laboratories, in addition to industrial and municipal wastes, are accepted. The site was opened in the 1930's, but the period over which hazardous waste has been accepted is not documented.

Available borehole and water-well logs indicate that the area is underlain by about 76 m (250 ft) of glacial drift with several continuous units of water-bearing sand and gravel over shale bedrock. The site is situated on land that slopes gently toward a drainage ditch. Three monitoring wells were finished in the drift at depths ranging from 6 to 12 m (20-40 ft) below ground surface. Water levels measured in these wells ranged in depth from 1.5 m (5 ft) in the southeast corner of the site to 4.6 m (15 ft) in the north-central portion of the property. The water table is presumed to slope in a northeasterly direction toward the drainage ditch.

Monitoring Wells 1 and 2, located 122 m (400 ft) and 3 m (10 ft) northeast of the fill, respectively, and Well 3 designated as background, 152 m (500 ft) southeast of the fill, were sampled in December 1976.

Water from Well 1 contained barium of 0.1 mg/l. Well 2 contained 0.08 mg/l of nickel and 0.2 mg/l of barium, neither of which was detected in Well 3. However, 0.01 mg/l of lead was detected in Well 3, but not in the others. The non-hazardous leachate constituents calcium, magnesium, iron, and sodium were all in elevated concentrations in Well 2 in comparison to Well 3. Thus, although lead was detected in Well 3, according to the other chemical data it does not appear to be contaminated with leachate. None of the samples contained detectable concentrations of organic compounds.

Site IL S-2. The site is located in northeastern Illinois, and consists of a 16-ha (40-acre) landfill. Wastes accepted at the site include municipal refuse, oils and solvents, inks, and sludges from metal plating and fabricating industries. Hazardous waste disposal began in 1972 and is still continuing.

Data from soil borings and observation wells indicate that the area is underlain by about 12 m (40 ft) of silty clay till over fractured dolomite bedrock. A layer of sand and gravel occurs just above the bedrock surface. Monitoring facilities consist of four wells finished in the till at depths ranging from 5 to 9 m (15-30 ft) below ground surface.

A well designated as background (east) and two monitoring wells were sampled in December 1976. Although the background

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well was located upgradient of the landfill, it was within 366 m (1,200 ft) of an agricultural field used for land-spreading of sewage sludge. The other wells were located 4.5 m (15 ft) west and 450 m (1,500 ft) north of the landfill.

Traces of halogenated compounds were detected in all of the samples, indicating contamination. The west well sample contained 950 mg/l of sulfate, 320 mg/l of calcium, and 310 mg/l of magnesium. There were no other results for comparison, but based on experience with ground-water chemistry, those concentrations would be considered above average and probably reflect leachate contamination.

Site IL S-3. The site is a 10-ha (25-acre) landfill located in northwestern Illinois. Municipal refuse, municipal sewage sludge, industrial oils, and metal finishing sludges are accepted. Hazardous waste has been accepted since 1972.

Soil boring data and well logs indicate that the area is underlain by about 9 m (30 ft) of loess and 37 m (120 ft) of silty clay and till overlying limestone bedrock. The site is situated near the Mississippi River on loess bluffs, which are dissected by steep ravines draining toward the river about three-quarters of a mile to the north.

The four monitoring wells at the site range in depth from 5 to 9 m (15-30 ft) below land surface. Three wells were sampled in December 1976; however, one well did not yield enough water for even a partial analysis. The two wells that were successfully sampled were located on either side of a drainage divide running through the site. Well 7 is located about 366 m (1,200 ft) north of the nearest fill material, and Well 2 is located approximately 91 m (300 ft) south of the fill. Well 7 was to provide an indication of background water quality, if the most recently deposited waste buried to the north of the drainage divide had not caused contaminated ground water to migrate as far downgradient as this well.

Both water samples contained traces of halogenated compounds, indicating contamination. Well 2 had 0.01 mg/l of copper, and Wells 2 and 7 had 0.2 and 0.1 mg/l of barium, respectively. The water sample from Well 2 contained much higher concentrations of sulfate, calcium, magnesium, chloride, and sodium than water from Well 7.

Site IL S-4. The site is located in northern Illinois, and consists of a 12-ha (30-acre) landfill. Hazardous waste disposal began in 1972 and includes municipal sewage sludge, municipal refuse, paint sludges, organic solvents, and metal plating sludges.

According to well logs and field observations, the area is underlain by up to 21 m (up to 70 ft) of sand and gravel over fractured dolomite bedrock. The site itself is an old gravel pit and rock quarry on the edge of the flood plain of a nearby creek. A 5.1-cm (2-in.) thick asphaltic liner, on the base and sides of the pit, and a leachate collection system were installed prior to landfilling.

Three monitoring wells are finished in the sand and gravel at depths ranging from 11 to 14 m (35-45 ft) below land surface.

The water table appears to slope to the west and southwest toward a creek. Water levels in the wells were within 6 m (20 ft) of land surface. The background water sample was collected from a tap at the scale house near the site entrance. The tap was connected to a residential well located about 152 m (500 ft) northeast of the fill, and is routinely substituted for the original background well that is often dry. Monitoring Wells 4 and 6 are approximately 152 and 213 m (500 and 700 ft) from the fill, respectively. These wells were sampled in December 1976. The wells were not heavily contaminated, but traces of halogenated compounds were detected in the three wells. Monitoring Well 6 also contained 0.1 mg/l of barium. The tap water sample contained 1.3 mg/l of zinc that is likely to have come from galvanized piping or the storage tank.

Site IL S-5. The site is a 16-ha (40-acre) landfill located in northeastern Illinois. Hazardous waste has been accepted since 1970 and includes municipal sewage sludge, industrial organic and heavy metal sludges, and industrial wash-down water. Trenches are lined with clay, and leachate is recirculated.

Soil-boring data and well logs indicate that the area is underlain by about 37 m (120 ft) of silty clay till, with sand and gravel lenses, over fractured dolomite bedrock. The site is bounded by a river on its eastern edge. Five 15-m (50-ft) deep monitoring wells are finished in the till.

Well 5, designated as background, is located about 610 m (2,000 ft) north of the disposal site. Monitoring Wells 3 and 4 are located between the fill and the river, approximately 152 and 15 m (500 and 50 ft) from the fill, respectively.

Samples from the three wells were collected in December 1976. Small concentrations of heavy metals, cyanide, and phenol were detected. Hazardous constituents present in one or more of the samples included chromium 0.01, nickel 0.1, barium 0.1, and cyanide 0.007 mg/l. Traces of halogenated organic compounds were detected in all samples.

Site IL S-6. This site is a landfill located in southwestern Illinois. The landfill is over 10 years old and has received solvents, resins, and other wastes from plastics manufacturing. Following two serious fires in 1974, the facility no longer accepts containers of unknown chemicals. The current permit does not allow hazardous waste disposal.

One monitoring well was sampled in March 1977. The well was finished at a depth of 4 m (13 ft), and was located about 27 m (90 ft) west of the filled area. A background sample was obtained from a well at a nearby location screened in the same aquifer.

Hazardous constituents that were present in concentrations above background were copper 0.01, nickel 0.10, lead 0.10, selenium 0.02, and barium 3.8 mg/l. Halogenated organic compounds were also present in trace amounts (less than 0.001 mg/l). Non-hazardous constituents were also present in concentrations up to several hundred times background. For example: chloride 4,156, calcium 890, and sodium 830 mg/l.

Indiana

Site IN S-1. This plant site is located in southwestern Indiana. It has two lagoons which are used to settle effluent from the industry's waste water treatment facility before being discharged to the ground surface. Hydraulic fluid containing PCB's is known to have been a component of the plant waste stream in the past, although recently PCB-free hydraulic fluids have been used.

Available well logs and field observations indicate that the area is underlain by about 6 to 12 m (20-40 ft) of residual clay soil over fractured limestone bedrock.

Since no monitoring facilities existed at the site, supply wells were inventoried. Three wells were chosen for sampling by considering their positions relative to the settling lagoons and surface drainage patterns. They are located 120 to 390 m (400-1,300 ft) from the lagoons in a valley draining to the east. A fourth sample was taken of surface-water discharge from the lower lagoon to characterize any hazardous constituents in the waste.

It should be noted that access to the site was requested through the Division of Water, Indiana State Board of Health, but access was denied by the site owner. Inspection and subsequent sampling of the residential wells and surface-water discharge were conducted off the property in the presence of an official from the State Board of Health.

Hazardous constituents detected in one or more of the samples above background and their maximum concentrations are cyanide 0.01, zinc 0.92, cobalt 0.01, and traces of halogenated compounds. The background well was free of contamination except for a trace of cyanide.

Site IN S-2. This site in northwestern Indiana is a landfill 16 ha (40 acres) in area and 12 m (40 ft) deep, with two industrial lagoons contiguous to it. The landfill accepts municipal and unknown quantities of hazardous industrial wastes. In addition to the waste deposited in the landfill, seepage from the lagoons enters the landfill. Suspected contaminants from the lagoons include heavy metals and organic substances.

Previous sand excavation operations indicate the presence of a glacial till about 30 m (100 ft) thick, which overlies dolomite bedrock. Infiltration from a river to the south, combined with ground-water inflow on the other three sides, filled the pit with water. Ditches and drains now direct water to a sump where it is pumped at an estimated 63 litres/sec (1,000 gpm) during the wet season. The quality of the sump discharge is better than the river water quality, reflecting other industrial discharge to the river.

A seepage area in the wall of the lagoon immediately to the west of the pit was the first sampling point (Seep 1). A second sampling point (Seep 2) at the base of the north pit wall showed signs of an oil/water mixture seeping through from a lagoon to the north of the site, and was chosen to check chemical quality of incoming ground water. The third sampling point chosen was the sump in the southeast part of the landfill pit (sump discharge).

Samples were collected in November 1976. Considerable contamination was present. Hazardous constituents and their maximum concentrations detected above background in the samples are chromium 0.01, arsenic 5.8, lead 0.3, cyanide 0.27, halogenated organic compounds 0.003, and heavy volatile organic compounds 0.06 mg/l.

Site IN S-3. The site is located in southwestern Indiana and encompasses a landfill which receives municipal refuse and about 1.5 cu m/day (2 cu yd/day) of mixed waste from a large ferrous metal industry. Hazardous components are suspected to be in the industrial waste. The age of the landfill is unknown, but industrial waste has been accepted for the past four years.

No well logs were available, but field observations indicate the immediate area of the site is underlain by about 24 m (80 ft) of sand over fractured limestone bedrock. The fill is situated atop a hill, and a spring feeds an intermittent stream draining to the west.

Since no monitoring facilities exist at the site, two water supply wells and a spring were sampled. Well 2 is 122 m (400 ft) northeast of the fill at a single residential trailer, while Well 1 is about 305 m (1,000 ft) to the north of the fill and supplies water to over 30 residential trailers. The seep/spring was sampled for detection purposes because it is fed from the south side of the sand hill upon which the fill is located.

The spring water sampled contained 1.1 mg/l of copper and 0.02 mg/l of heavy volatile organic compounds. Well 1 had no organic contamination, but showed 0.03 mg/l of cobalt above background.

Site IN S-4. The site is located in southwestern Indiana and has an open dump which is presently inactive. A variety of industrial wastes have been dumped, including PCB-containing materials. Open dumping began in the late 1950's and continued until 1972 when the site was closed. Available well logs and field observations indicate the area is underlain by up to 3 m (up to 10 ft) of clayey residual soil over highly fractured limestone bedrock.

Since no monitoring facilities existed at the site, four water wells located 274 to 457 m (900 to 1,500 ft) from the dump site and two seeps were inventoried and sampled. The wells included two residential supply wells tapping the limestone and a shallow dug well finished in the residual soil. All are located in a valley southwest of the fill. A seep from the face of the fill and one from the bedrock downhill and northwest of the site were sampled. An additional residential supply well finished in the limestone and located to the east of the fill was sampled for background quality.

Water samples collected in November 1976 from the seeps were contaminated with chromium, nickel, selenium, barium, and cyanide. Selenium at 0.01 mg/l concentration was also detected in all of the wells. Well 3 was found to contain .003 mg/l of halogenated organic compounds.

Site IN S-5. The site, in northeastern Indiana, is a landfill which had been an open dump before 1969. Open dumping began in the early 1950's with deposition of unknown quantities of potentially hazardous industrial wastes. Available borings and well logs indicate the area is underlain by 24 to 27 m (80-90 ft) of sandy clay, sand, and gravel over limestone bedrock.

Existing monitoring facilities at the site consist of five wells finished at depths varying from 3 to 4 m (9-14 ft) below ground surface. Water levels measured in these wells show an average depth to the water table of 1.8 m (6 ft). The hydraulic gradient at the site could not be determined, so all five monitoring wells were selected for sampling because they are distributed around three sides of the fill at distances of 60 to 230 m (200-750 ft).

Samples were collected in November 1976. Hazardous constituents and their maximum concentrations present in one or more of the wells above background are cyanide 0.03, barium 1.1, and heavy volatile organic compounds 0.03 mg/l. Samples also contained traces of halogenated organic compounds.

Massachusetts

Site MA S-1. The site, a landfill located in north-central Massachusetts, occupies an area of 14 ha (35 acres) and has been operating about 25 years. Plastic manufacturing wastes, including liquids, are accepted. Sewage sludge is also disposed of in one part of the landfill.

The landfill is located on the south side of a river on the flood plain about 0.8 km (0.5 miles) in width. Ground-water movement is northward toward the river. Depth to bedrock at the site is unknown; however, at a proposed background well location adjacent to the site drilling refusal was reached at about 15 m

(50 ft), and it is likely that depth to bedrock is less than 30 m (100 ft) in the area. Till predominates, although some coarse stream gravels may be found locally, as at Well 2.

Four holes were drilled in October 1976, but only one was finished in material permeable enough to yield water. Thus, no background data is available. Well 2 was finished in a sand and gravel formation that yielded clear water with an organic solvent odor.

The presence of 0.01 mg/l of chromium, 0.04 mg/l of copper, 0.97 mg/l of zinc, 0.07 mg/l of selenium, traces of halogenated organic compounds, and higher than usual concentrations of non-hazardous leachate indicators, provide convincing evidence of leachate and hazardous substance contamination.

Site MA S-2. The site is located in north-central Massachusetts, and consists of a landfill integrated with a small lagoon. The landfill, in operation since 1971, is about 91 m (300 ft) square and about 9 m (30 ft) deep. The lagoon, located in the landfill center, is 12 m (40 ft) in diameter. Acid pickling waste is lagooned after neutralization with soda ash. Most of the solid refuse is of municipal origin, but some wool-processing wastes are also included.

Geology consists of thick glacial overburden and recent bog sediments atop crystalline metamorphic bedrock which outcrops at the southwest corner of the site. Ground-water flow appears to be generally northward and locally from the landfill in all directions into swamps surrounding the site on three sides. The bedrock outcrop suggests a hydraulic boundary west of the site.

Three wells 4.3 to 5.3 m (14-17.5 ft) deep were drilled in November 1976, and had water levels of 1.2 to 1.5 m (4-5 ft) below grade. Well 1 was screened in fine silty sands, while Wells 2 and 3 were screened in very coarse gravels. Well 3 was drilled adjacent to a large pond 152 m (500 ft) south of the site. All of the wells were drilled along an abandoned railroad right-of-way.

Water from Well 2 contained nickel, 0.04 mg/l; arsenic, 0.65 mg/l; barium, 0.1 mg/l, and cobalt, 0.08 mg/l; all of which are above background concentrations. Traces of halogenated organic compounds and volatile organic compounds were also detected. Well 3 was located where landfill contamination was thought to be unlikely. However, traces of halogenated organic compounds and volatile organic compounds were also detected in Wells 1 and 3. This indicates that the organic contamination may have resulted from oils being spread by rolling stock or from leaching of wood preservatives along the railroad bed. The inorganic contamination appears to have come from the landfill.

Site MA S-3. The site, located on Massachusetts' southwestern coast, has operated as a municipal refuse dump since 1926, and as a sanitary landfill since 1971. Incineration facilities dating from the early 1920's are on site. It is estimated that 36 ha (90 acres) have been filled to a depth of about 4.5 m (15 ft) with wastes of all types. At least 227,000 kg (500,000 lb) of this waste is PCB-containing industrial materials from electronics manufacturing. An undetermined quantity of liquid PCB's has been dumped.

Site topography consists of wetlands with glacial lake deposits 12 to 15 m (40-50 ft) thick over bedrock. A layer of peat about 2.4 m (8 ft) thick covers the glacial deposits and was penetrated by all borings. Ground water was 0.6 m (2 ft) or less below land surface. Since peat is more permeable than the silty lake deposits it is probable that most ground-water flow (and leachate migration) is through the peat.

Four observation wells were installed in March 1976 using well points set at depths ranging from 3.3 to 4.8 m (11-16 ft). The wells are located along the bottom of the western landfill slope, about 15 m (50 ft) from the edge of the fill. Sampling of Wells 1 through 3 took place in November 1976. No background well was available for sampling, and Well 4 was inaccessible.

Copper was the only toxic heavy metal observed in the samples, and its maximum concentration was only 0.01 mg/l. Traces of halogenated organic compounds, presumably PCB's, in concentrations of less than 0.001 mg/l were detected in each of the three samples. The concentrations were too low for quantification of the components. The non-hazardous constituents were of virtually the same concentration in all samples and showed no apparent effect from leachate.

Site MA -4. The site is located in extreme western Massachusetts, and consists of a landfill with incineration facilities. The landfill occupies an area of about 14 ha (35 acres). A variety of industrial wastes are received, with PCB wastes the only kind identified chemically. The landfill began operation in 1953, and accepted PCB's until 1970.

The landfill is located on river flood plain sediments in a 2.4-km (1.5-mile) wide valley, between bedrock highlands which rise 183 to 244 m (600 to 800 ft) above the valley floor. The thickness of unconsolidated sediments at the site is unknown. The normal ground-water movement is toward the river, although flood-stage river conditions may reverse the direction for short periods. The character of unconsolidated sediments indicates a high probability of rapid leachate migration away from the site.

Three wells were drilled in November 1976. Two monitoring wells are located between the landfill and the river, and a background quality well. Wells 1 and 3 were installed for monitoring and Well 2 for background. Well 1 produced the most mineralized water containing the following components in mg/l: selenium 0.08, chromium 0.01, nickel 0.05, barium 0.1, and a light volatile organic compound 1.2. Calcium, magnesium, sodium and iron were in elevated concentrations, giving further evidence of leachate contamination. Well 3 produced water containing two light volatile compounds with concentrations of 10.3 and 5.6 mg/l.

Site MA S-5. The site is located in south-central Massachusetts and consists of a 1.9 ha (4.6 acres) landfill having an average thickness of about 11 m (35 ft). The landfill is situated on a point of land bounded by rivers and has been operating since the early 1970's. No tabulation of waste type (domestic, commercial, or industrial) has been made. Site personnel report receipt of industrial wastes with liquid wastes that are spread indiscriminately on the surface. An incinerator, fly-ash lagoons, and a sewage treatment plant are located adjacent to the landfill.

The landfill is located in a large river valley on flood plain sediments at the confluence of two major rivers, placing the site on a peninsula. The thickness of unconsolidated sands, gravels, and clays is reported to be 30 m (100 ft) or more. Ground-water flow is divided along the southeast trending axis of the peninsula (ground-water divide).

Four wells were drilled in November 1976. They were screened in fine to coarse sand which underlies an apparent alluvial deposit of finer texture. Wells 1, 2, and 3 are situated downgradient of south-flowing ground water recharged at the landfill. Well 4 (background) is located on the river bank about 427 m (1,400 ft) west of the expected path of leachate flow.

A composite water sample from Wells 2 and 3 contained chromium 0.01, selenium 0.02, barium 0.1, and volatile organic compounds 1.0 mg/l. Well 1 also contained chromium, selenium, and barium. The background well (Well 4) showed slight contamination as 0.01 mg/l of chromium and 0.03 mg/l of selenium. Also, 2.1 mg/l of volatile organic compounds were detected. An industrial development upgradient of the well could have affected water quality in the background well, and, therefore, background data is considered inadequate at this site.

Michigan

Site MI S-1. The site is located in southwestern Michigan, and has a waste water lagoon facility located on the property of a metal finishing plant. Metal plating waste containing heavy metals and cyanide is pumped into a seepage lagoon, the third in operation since construction of the plant--the first two lagoons were abandoned in 1973. Effluent discharge to the lagoon is estimated at 4.4 litres/sec (69 gpm).

Soil boring data and well logs indicate that the area is underlain by about 30 m (100 ft) of glacial drift over shale bedrock. The upper 21 m (70 ft) of drift consists of sand and gravel with minor clay lenses which become more predominant in the lower sections of the drift. The three monitoring wells are finished in the sand and gravel at an average depth of 20 m (66 ft). The two supply wells for the plant are completed in the sand and gravel at depths of 21 to 23 m (70-75 ft) below land surface.

Monitoring Wells 2 and 3 are located about 45 m (150 ft) northwest and 30 m (100 ft) southwest of the active lagoon, respectively. The background well serves a residence about 400 m (1,300 ft) west of the active lagoon and was free of contamination. Sampling took place in September 1976.

Monitoring Well 2 was the most contaminated, and its water sample contained 0.36 mg/l of chromium, 2.8 mg/l of copper, 0.67 mg/l of nickel, 0.01 mg/l of hexavalent chromium, 0.0008 mg/l of mercury, 0.08 mg/l of selenium, 0.15 mg/l of molybdenum, 0.05 mg/l of cobalt, and 14 mg/l of cyanide. Traces of chlorinated phenols were also detected in this sample. The water sample collected from the plant supply wells contained 0.63 mg/l of cyanide. The relatively high sulfate and chloride concentrations observed in the monitoring wells probably reflect acids in the waste water.

Site MI S-2. The site is located in southeastern Michigan, and consists of a 9-m (30-ft) diameter dry well that receives treated acid pickling liquor from a steel treatment process. The waste contains iron, oils, and traces of cyanide. When disposal began in the early 1950's, a leaching pit was used. This was abandoned in 1971 when the dry well was installed. The pickling liquor is not a constant component of the total waste, but is usually discharged once a week.

The area is underlain by glacial drift to a depth of 30 m (100 ft). The drift is composed primarily of sand and gravel with clay lenses. The site is situated on land sloping to the east toward a lowland marsh and lake, a distance of about 213 m (700 ft) from the plant.

No monitoring wells have been installed, but three water supply wells finished in sand and gravel were sampled in September 1976. The well used for background serves a residence about 550 m (1,800 ft) northwest of the disposal well.

Selenium and barium were found in the water from Well 1, at their detection limits. Water from Well 2 contained nickel at a concentration of 0.01 mg/l. Water from the background well showed no heavy metals.

Site MI S-3. The facility, located in the north-central region of Michigan, is a seepage lagoon on the property of a copper and brass tubing fabricator. The lagoon receives treated rinse water from pickling solutions used in the sulfuric acid and dichromate dip processing of the metals. From the early 1940's until 1959, the effluent was discharged to a tile field east of the plant. A lagoon was then constructed, covering 511 sq m (5,500 sq ft), which receives about 25,450 litres/day (6,700 gal./day) of effluent.

Glacial outwash underlies the site to a depth of at least 21 m (70 ft). The outwash is composed of sand, gravel, and minor amounts of sandy clay. Below the outwash materials, clay strata 3 m (10 ft) or more in thickness are present. The site is situated on fairly flat land sloping gently to the north and northeast toward an extensive lowland marsh, about 1.6 km (1 mile) from the property.

There are nine monitoring wells finished in the sand and gravel at depths of 9 to 14 m (30-45 ft) below land surface. Monitoring Wells 1 and 3 are downgradient and upgradient of the lagoon, respectively. Two water supply wells are located 91 m (300 ft) and 213 m (700 ft) southwest of the lagoon.

An engineering report, received after samples were taken, noted that sludge from the bottom of the lagoon was removed and buried just south of Well 3. The report also noted that new galvanized iron pipe was used for well casing in the monitoring wells. Zinc concentrations in the samples reflected the contact of the water with zinc-coated casings.

Hazardous constituents above background, present in one or more of the monitoring wells, noted with their maximum concentrations are 0.03 mg/l of copper, 0.03 mg/l of nickel, 31.0 mg/l of zinc, 0.06 mg/l of cyanide, 0.1 mg/l of barium, 0.0005 mg/l of mercury. Traces of organic compounds were found in all wells. None of the wells were completely free of contamination. Well 1 was the most mineralized, as evidenced by relatively higher concentrations of non-hazardous constituents.

Site MI S-4. The site has a tile drainage field that receives process waste water from an electronics manufacturing plant, and is located in central Michigan. The treated effluent contains trace quantities of mercury and other heavy metals. Disposal began in the mid-1950's when effluent was discharged into a seepage pond near the present tile field. In 1971 this pond was abandoned and filled. Effluent was diverted to three new seepage ponds until the present system became operative in 1975. Waste water discharge amounts to about 2,270 litres/day (600 gal./day) and the tile field covers about 111 sq m (1,200 sq ft).

Available geologic data indicate that the area is underlain by glacial deposits to a depth of at least 60 m (200 ft). The deposits are composed of layers of sand and gravel separated by clay strata of varying thicknesses. The site is situated on fairly flat land sloping gently toward an area of marshes and water-filled gravel pits.

There are three monitoring wells installed in sand and gravel at depths of 3.6 to 4.3 m (12-14 ft) below land surface.

The service building well and boiler house well are finished in sand and gravel at depths of 58 m (190 ft) and 27 m (90 ft), respectively, at a distance of about 91 m (300 ft) from the tile field and abandoned seepage pond. The north well (monitoring) is located about 61 m (200 ft) south of the tile field and about 46 m (150 ft) west of the filled seepage pond.

Three wells were sampled in October 1976. The service building well showed traces of chlorinated phenol, but otherwise appeared free of contamination. The boiler house well water showed a similar analysis of phenol, but also contained 0.01 mg/l of cyanide as did the north monitoring well. In addition, the north well water contained 0.02 mg/l of copper, 0.08 mg/l of nickel, 0.01 mg/l of selenium, 0.17 mg/l of cobalt, and elevated concentrations of sulfate, calcium and sodium.

Site MI S-5. The site is located in west-central Michigan, and includes four liquid waste lagoons on the site of an engine manufacturing plant. Liquid waste which contains aluminum, cadmium, chromium, cyanide and zinc is pumped to the lagoons from the plant. The lagoons are about 3 m (10 ft) deep and cover less than an acre. Averaged over one year, the daily volume of effluent is estimated at 75,700 litres (20,000 gal.). Soil borings and well logs indicate that the area is underlain by sand and minor amounts of gravel to a depth of at least 18 m (60 ft).

Four monitoring wells are finished in sand at depths of 14 to 15 m (45-50 ft) below land surface. Water-level data were inadequate to define the ground-water gradient. Well 1 is located 91 m (300 ft) east of the lagoons, and Wells 2, 3, and 4 are on the north, west, and south sides of the lagoons, respectively.

The wells were sampled in October 1976. Water samples from monitoring wells contained one or more of the following hazardous constituents above background, given at their maximum concentrations: 0.07 mg/l of copper, 0.02 mg/l of nickel, 2.9 mg/l of zinc, 0.02 mg/l of selenium, 0.04 mg/l of cyanide, and 0.003 mg/l of organic compounds. Mineralization by non-hazardous constituents were particularly noticeable in samples from Wells 3 and 4.

New Hampshire

Site NH S-1. The site is located in southeastern New Hampshire, and consists of a 24 ha (60 acres) landfill. The landfill accepts primarily municipal trash with significant quantities of industrial waste from plastics and leather tanning industries. The filled area rises 4.6 m (15 ft) above swampy lowlands which border it on three sides. Operations commenced in 1961 and the site is presently active.

Geologic conditions are characterized by thin unconsolidated deposits, mainly till, in elevated areas, and thicker, fluvial or lacustrine sediments in the lowlands. Numerous springs, swamps, streams and ponds are found in the lowlands.

In November 1976, two monitoring wells were drilled at downgradient locations, both being screened in fine sands. Well 2 was drilled at the south landfill boundary, opposite a tannery sludge dump, and Well 3 on the north boundary, adjacent to a plastics waste disposal area. Other liquid waste, probably sewage sludge, is discharged indiscriminately at various locations. A shallow dug well, serving as a domestic supply, was sampled for background water quality at an upgradient location about 550 m (1,800 ft) from the landfill.

The sample from Well 2 was the most mineralized, and contained 0.03 mg/l of selenium, 0.2 mg/l of barium, and 0.002 mg/l of PCB's, all above background concentrations. Iron and chloride, frequently indicators of leachate, were above background concentrations. Organic contamination included other halogenated organic compounds, and eight light volatile organic compounds. The volatile compounds are not characterized beyond relative boiling points. They could be hydrocarbons, solvents, or a mixture of non-halogenated compounds. Well 3 yielded water with selenium in a concentration above background and 28 mg/l of light volatile organic compounds. The background water sample was collected from a domestic well. No organic constituents were found in water from the background well.

Site NH S-2. This 18-ha (45-acre) site, located in extreme southern New Hampshire, has been accepting a variety of municipal and industrial wastes since opening in about 1970. Sludge from paint manufacturing is considered to be a major hazardous waste.

Topography consists of gently sloping land with low hills, gradually decreasing in average elevation to the west, where a major river is located about 914 m (3,000 ft) west of the landfill. Subsurface geology consists of glacial ice-contact and outwash deposits in lowlands, with till in the higher areas. Unconsolidated deposits are generally less than 9 m (30 ft) thick, overlying crystalline bedrock. Ground-water movement is considered to be almost due west where discharge to the river occurs. Rapid leachate migration through the coarser outwash deposits is highly probable, with velocities lowered considerably where till or other less permeable overburden occurs.

Three wells were drilled outside of filled areas. Water levels ranged from 2.4 to 4.3 m (8-14 ft) below grade. Wells 1 and 2 were located downgradient of the fill area and Well 3 upgradient to serve as a background monitoring point.

Water from Wells 1 and 2 contained one or more hazardous constituents. Maximum concentrations in mg/l were selenium 0.09, barium 0.1, PCB's 0.002, and light volatile organic compounds 171 (combined). The background well was not contaminated with these constituents.

New Jersey

Site NJ S-1. The site is located in southeastern New Jersey and encompasses a 6.9-ha (17-acre) dry lake formerly used as a lagoon for liquid chemical wastes. Liquid wastes were discharged from tank trucks through a spillway to the lagoon. The site is now abandoned, and no records are available to indicate the total amount of waste discarded at the site. The former site owners produced pharmaceuticals and pesticides.

Five wells with 10-cm (4-in.) casings, and two borings with 3.2-cm (1-1/4-in.) casings, comprise the monitoring facilities. Boring 1, located about 30 m (100 ft) from the lagoon, and

Well 3, about 137 m (450 ft) away, were chosen as being potentially suitable for leachate sampling. Well 1 was installed as a background well, a little over 305 m (1,000 ft) upgradient of the lagoon. The lagoon is located in the recharge area of a major aquifer.

Hazardous constituents above background detected in Boring 1 and Well 3 were 0.15 mg/l of chromium, 0.81 mg/l of copper, 0.04 mg/l of cobalt, and 0.003 mg/l of PCB-like compounds. Zinc was detected in high concentration (240 mg/l) in Boring 1, but was probably derived from galvanized materials in the screen or casing. The background well did not show contamination.

Site NJ S-2. The site, located in southwestern New Jersey, consists of a 20-ha (50-acre) landfill. At the time of sampling (August 1976) the landfill was accepting only shredded automobiles, as a result of State imposed restrictions. Previously, municipal and industrial wastes and sewage sludge had been disposed of, creating a fill about 24 m (80 ft) thick.

The landfill is located on a flood plan near a tidal marsh and a small stream. It is underlain by a thick layer of clay. The low permeability of the clay probably causes most of the leachate to discharge directly into the nearby creek.

Two wells were installed. Well 1 was located about 80 m (260 ft) east of the landfill. Well 2 was located across the creek about 137 m (450 ft) west of the landfill. The combination of copper (0.01 mg/l), nickel (0.2 mg/l), and zinc (0.06 mg/l) in Well 1 indicates leachate contamination. The location for Well 2 was chosen to show that migration of leachate beneath the creek was unlikely, and apparently such was the case. Neither well showed organic contamination.

Site NJ S-3. This site, in east-central New Jersey, contains a landfill/lagoon combination. The facility received liquid, sludge, and solid industrial wastes. The lagoons were excavations in the top surface of the landfill into which liquid industrial wastes were poured. (When possible, acid and alkaline wastes were mixed to effect neutralization.) The landfill was closed to hazardous wastes in August 1976 by the New Jersey Department of Environmental Protection.

The landfill is situated less than 305 m (1,000 ft) from a major river in a marine tidal marsh. A diabase dike underlies at least the southern section of the landfill, but its extent has not been entirely determined. Overlying the diabase is a shale formation, which in turn is overlain by clay. The clay and shale are of very low permeability. A layer of sand and gravel in some places rests upon the clay. Leachate springs were noted at several locations near the base of the landfill. The leachate drains overland to the marsh.

In June 1976, eight wells were installed ranging in depth from 4.6 to 12 m (15-40 ft). The wells were located on the west, south, and east sides of the filled area. The background well (Well 6) was located about 137 m (450 ft) northeast of the landfill.

Brackish ground-water conditions made the contribution of sodium, chloride, and other associated ions by leachate difficult to assess. The only detectable heavy metal in ground water was lead (19.0 mg/l) found in water from a well between the landfill and river. Organic contamination, however, was severe. Toluene, xylenes, alkyl benzenes, alcohols, methyl ethyl ketone, camphor, naphthalene, and benzene were all detected in one or more of the monitoring wells, but not in the background. Another well close to the river on the northwest side of the landfill which was expected to be contaminated was also free of organic substances. One ground-water sample contained cyanide.

Site NJ S-4. This site is located in south-central New Jersey and covers approximately 2.8 ha (7 acres). It was once operated as a liquid chemical waste recycling or treatment plant, but is now abandoned. Several lined lagoons remain, with one still half-filled with a greenish-yellow liquid chemical waste. The liners are useless because over 50 percent of the lining material has been destroyed. In addition, traces of powdered chemicals and discarded drums of chemical waste are scattered and buried on the site.

The site is situated directly above a major aquifer in the Pine Barrens region of the state. A large number of dead trees around the perimeter of the site and extending for hundreds of feet beyond at several points provides surface evidence of ground-water contamination damage. Four monitoring wells were drilled in August 1976, with well logs reporting fine to medium sand. Clay layers, if present, were too thin to be detected by the auger method of well drilling.

Monitoring Wells 1, 2, and 4 were installed southeast of the lagoons, and Well 3 was installed about 213 m (700 ft) northeast of the site as a background well.

Chromium was present in a concentration of 420 mg/l in Well 2 and 1,200 mg/l in a sample of the lagoon liquid. Water from Well 1 contained 0.07 mg/l of nickel and 0.24 mg/l of selenium, all above background. Organic contaminants were found in the sample from Well 2; there were traces of halogenated compounds and 200 mg/l of light volatile compounds. The background sample (Well 3) contained 0.1 mg/l of selenium, but no organic substances.

Site NJ S-5. The site is located in southwestern New Jersey and consists of a 24-ha (60-acre) landfill with refuse accumulated to an average depth of about 12 m (40 ft). The landfill accepts municipal wastes, sewage and sewage sludge, and non-chemical industrial waste. However, during inspection, a number of uncovered containers of sodium azide were observed in the working face. Sealed drums of chemical wastes are also alleged to be buried on the premises.

The age of the landfill is not known, but refuse has been accumulated to an average depth of about 12 m (40 ft). The landfill is located on a formation which is one of three major aquifers in the region. Leachate generation is estimated at more than 4.4 litres/sec (100,000 gal./day), some of which is collected and recirculated back to the top of the landfill. Three wells were installed and sampled in August 1976. Fine to coarse sand with little silt was encountered during drilling. Wells 1-S and 1-D, 396 m (1,300 ft) downgradient, are screened 2.5 to 3.8 m (8.5-12.5 ft) and 15.5 to 16.8 m (51-55 ft) below land surface, respectively. Well 2 is 46 m (150 ft) upgradient of the landfill at a location thought to be representative of ambient water quality.

Well 1-S yielded water with a concentration of organic compounds above background; halogenated compounds were measured at 0.005 in Well 1-S. Well 1-D yielded water containing 0.006 mg/l of mercury.

Site NJ S-6. This site, in southwestern New Jersey, has an abandoned landfill of approximately 4 ha (10 acres). Soil cover and vegetation prevented an exact measurement of size. Large amounts of solid and liquid industrial chemical wastes are alleged to have been deposited.

The site overlies a major regional aquifer and has a flat, sand-covered surface that intercepts precipitation, with a large proportion probably infiltrating the landfill. Several extensive leachate seeps are apparent along the northern toe of the fill.

Four wells were installed and sampling was attempted in August 1976. However, no sample could be obtained from Well 4. Wells 1, 2, and 4 were located 162, 70, and 305 m (530, 230, and 1,000 ft) downgradient of the landfill, respectively. Well 3 was installed about 18 m (60 ft) upgradient. Silt and clay were encountered in drilling. Only Well 2 was easy to pump.

The sample from Well 2 contained zinc 0.40, barium 0.6, selenium 0.01, light volatile organic compounds 4.1 mg/l, and traces of halogenated organic compoundr, all above background.

The Well 1 sample also had zinc and selenium concentrations above background. Other constituents were generally more concentrated in samples from Wells 1 and 2 than in the background sample.

Site NJ S-7. The site is located in southeastern New Jersey and has lagoons that receive effluent from organic chemical manufacturing. It is believed that the lagoons are not lined. They are located on permeable material that comprises the outcrop of a major aquifer.

Three observation wells were installed within 30 m (100 ft) of the lagoons. These observation wells were utilized for sampling in this project. A service station supply well about 1.6 km (1 mile) away from the site was sampled for background water quality.

Inorganic constituents in the water samples were found in relatively low concentrations. For example, the most mineralized water contained only 60 mg/l of sulfate and 48 mg/l of chloride. However, the water from the observation wells had a distinct odor and contained traces of halogenated organic compounds similar to PCB's. The analytical data suggest that the contaminants may be polybrominated biphenyls (PBB's). In previous samplings by the State, no contamination had been found because only inorganic analyses were performed. Water from the background well also contained traces of halogenated compounds, and, therefore, background data for the site is considered inconclusive.

Site NJ S-8. This site, located in southeastern New Jersey, has a landfill which receives chemical processing wastes, much of it in barrels. The landfill is located on plant property, but receives wastes from at least one other plant owned by the same company. Many of the waste containers are buried and have corroded and leaked.

The site overlies the recharge area of a major aquifer which is tapped by supply wells in the area. A nearby river is the natural discharge area for the aquifer. The landfill owners had installed a number of wells for ground-water monitoring. Two of these were sampled in October 1976. Well 8 was located about 152 m (500 ft) downgradient from the landfill, while Well 1 was located several hundred feet upgradient for background water quality sampling.

The water sample collected from Well 8 was contaminated with 0.01 mg/l of chromium, 0.04 mg/l of cobalt, 0.2 mg/l of barium, and 0.01 mg/l of selenium. Also, traces of halogenated organic compounds, 12 volatile organic compounds, and seven light volatile compounds were detected. All of these constituents were above background. Water withdrawn from Well 8 also contained elevated levels of sulfate, calcium, magnesium, chloride, iron, potassium, sodium, and copper.

Site NJ S-9. The site, located near the Delaware River in southern New Jersey, contains a number of storage tanks and lagoons. There is a history of spills on the ground surface. Several production and monitoring wells are on the site; however, access was restricted, resulting in only three of the production wells being sampled in February 1977.

The site is situated on the outcrop of the Magothy-Raritan aquifer, the principal aquifer in southern New Jersey. The piezometric surface in the aquifer has been greatly depressed by pumping and ground-water flow is controlled by the major pumping centers. Because of substantial pumping at this site, ground-water flow beneath it would be to the production wells.

Well 1 was contaminated with chromium 0.01, copper 0.04, nickel 0.07, zinc 0.40, cobalt 0.22 mg/l, and volatile organic compounds probably including trichloroethylene. Wells 2 and 3 were contaminated with copper, cobalt, and trichloroethylene. The non-hazardous constituents chloride, sodium, iron, and sulfate were also found in higher than background concentrations. The background well was located in the same aquifer off the site and no contamination was detected.

New York

Site NY S-1. This northeastern New York State site of 8.9 ha (22 acres) contains an abandoned, open-burning municipal landfill which occupies about half of the property. During its active life (1953 to 1965), it received large quantities of electronics manufacturing wastes containing PCB's and pesticides. Disposal methods incorporated burning and dumping of refuse over a steep embankment 12 m (40 ft) in height.

Highlands, upon which the fill is situated and also upgradient from the landfill, appear to be underlain by sand, gravel, and probably glacial till. Low, marshy lands, which extend from the base of the uplands to nearby surface-water bodies, are reported to consist of clays and silts over carbonate bedrock. The lowland downgradient of the landfill is dissected by an abandoned barge canal and numerous small streams, one of which originates at the fill face.

Two wells were drilled during field operations in November 1976. Monitoring Well 1 (downgradient) penetrated only clays near the landfill toe, striking refusal at about 15 m (50 ft). A spring was also sampled. Well 2 (background) was drilled in a sand pit adjacent to the landfill property through fine to medium sands to a depth of 9 m (30 ft).

The sample from the spring showed the greatest contamination. A total concentration for eight PCB compounds of 0.006 mg/l was present. Heptachlor (an insecticide) was also detected but at less than 0.001 mg/l. Well 1, downgradient of the landfill, did not yield enough water for a complete analysis, but zinc and PCB's were detected. The background water sampled was uncontaminated.

Site NY S-2. The site consists of a 63-ha (156-acre) municipal landfill. General refuse with some industrial wastes is disposed of by trench fill, with compaction and earth cover. Septic and industrial sludges are spread on the surface in a designated area.

Well-boring logs indicate that overburden at the site consists of glacial till, in which clays predominate, with silts and some fine gravel. This lithology is consistent with the extremely low yields noted. Ground-water movement through the glacial till is probably quite slow except in zones of coarser material such as buried stream channels, etc. The numerous surface springs indicate the location of these features. No bedrock outcrops were observed but bedrock is reported to be limestone and dolomite. Leachate percolation into bedrock is likely, especially where the thin till overburden is breached while trench filling.

Four PVC monitoring wells have been installed since 1971. These were checked during site inspection in October 1976. In addition, two spring boxes and a dug well, which serve or have served for water supply, are located in potential monitoring locations.

Sampling in December 1976 found one monitoring well frozen, two unable to yield water after being bailed dry, and one yielding sufficient water for only partial analysis. The dug well and one spring box were in operation. For background water quality another dug domestic well, upgradient from the site, was sampled.

Water samples from the spring and monitoring well contained copper (0.05 and 0.03 mg/l, respectively) in concentrations above background (not detectable). The spring sample also contained selenium (0.01 mg/l), and water from Well 4 contained 0.5 mg/l barium. No organic contamination was detected.

Site NY S-3. The site is located in northeastern New York west of the Hudson River, and consists of a 10-ha (26-acre) landfill, about half of which is filled to a height averaging 6 m (20 ft). Municipal wastes, large quantities of industrial trash, liquid, and sludge wastes from one of the largest leather goods manufacturing centers of the state, are accepted. It has been in operation for 16 years.

The topography consists of generally flat or gently rolling ground surface, punctuated by numerous northeast to southwest oriented hills or drumlins. The landfill is situated on the edge of a broad, flat, swampy plain, the probable product of glacial melt water flooding. Bedrock consists of carbonates with generally horizontal bedding. The unconsolidated deposits are of unknown thickness. At Wells 1 and 2, closest to the filled area, medium sands, apparently kame terrace or other outwash deposits, predominated. At Well 3, farther north, fine sands and silts with a fairly high clay content were penetrated. Numerous sand pits in the vicinity suggest a wide areal extent of the coarser-grained sediments, creating a potential for rapid and far-reaching leachate migration.

Ground-water levels were shallow at the monitoring wells. Only Well 2, about 15 m (50 ft) from the fill, yielded water with an odor indicative of leachate contamination. In addition to the three monitoring wells installed and sampled in November 1976, an existing well supplying the landfill garage and a background residential supply well near the landfill entrance were sampled. The background well is upgradient from the landfill.

Water samples from Wells 2 and 3 were the only ones showing hazardous constituents. The sample from Well 2 contained cyanide (0.008 mg/l), traces of halogenated compounds (PCB's or similar), and two light volatile compounds (0.22 and 0.01 mg/l), one of which was phenolic. Water from Well 3 contained selenium

(0.02 mg/l) above background concentration. Iron, manganese, and chloride in Well 2 were also in elevated concentrations, indicative of leachate contamination.

Site NY S-4. The site is located in southeastern New York State, west of the Hudson River, and occupies approximately 162 ha (400 acres). About 3 ha (7.5 acres) are presently filled, as the landfill has been in operation only about three years. A variety of municipal and industrial wastes are received including sewage sludge.

The local geomorphology describes a river flood plain, the site being bounded on three sides by flowing surface water. Subsurface geology, defined by soil borings, consists of glacial till underlying about half the site, the remainder being coarse-grained fluvial deposits of glacial or post-glacial origin. The probability of leachate migration is low for the till and very high for the fluvial sediments.

Three monitoring wells, 21 to 24 m (70-78 ft) in depth, were installed near the site perimeter. A potable well reported to be 22 m (73 ft) deep serves a weigh-station office at the entrance. Depth to ground water averaged about 4.6 m (15 ft) in the existing wells.

Water samples from Wells 1 and 3 contained identical concentrations of barium, cobalt, and halogenated compounds, 0.1, 0.01, and less than 0.001 mg/l, respectively. None of these constituents were present in the background Well 5.

Site NY S-5. The 223-ha (550-acre) site is located in west-central Long Island in southeastern New York, on the Atlantic Coastal Plain. This is a waste disposal complex consisting of a municipal landfill and a number of industrial lagoons, with plating and other metal wastes plus various organics comprising the main hazardous materials. The landfill dates back to the 1930's; however, industrial activity with liquid waste lagoons and waste dumps did not begin until the early 1950's. Sewage sludge and additional industrial wastes have been incorporated into the municipally-owned landfill.

The geology of the site consists of thick unconsolidated deposits divided into two aquifers overlying crystalline bedrock approximately 305 m (1,000 ft) below land surface. The principal aquifer which could potentially be affected by the waste disposal facilities ranges from the water table, at about 29 m (95 ft), to about 198 m (650 ft) below land surface where a major aquiclude is encountered. This aquiclude confines water in a deeper aquifer which exists from roughly 244 to 305 m (800-1,000 ft) below land surface. The site is located on the roughly defined ground-water divide where recharge is believed to move almost vertically downward into the lower reaches of the principal aquifer.

A test well was drilled during January 1977, and three zones were tested during the reverse rotary drilling process: first at 57.6 to 63.7 m (189-209 ft), second at 109 to 115 m (358-378 ft), and third at 160 to 166 m (525-545 ft). After drilling, test pumping, and geophysical logging, three permanent

3-cm (1-1/4-in.) PVC wells were installed in the drilled hole, with screens set at elevations which reflect the original test screen settings.

Halogenated compounds were detected in water from the shallowest screen setting in a total concentration of 0.001 mg/l for four compounds. The second screen setting also yielded similar compounds, but in concentrations less than 0.001 mg/l.

Two public supply wells and a well at a manufacturing plant were utilized as additional monitoring wells because of their proximity to the landfill. Water from Well 7-2 contained 0.08 mg/l of copper and 0.01 mg/l of selenium; Well 8 yielded water with 0.05 mg/l of copper. These data are not definitive enough to conclude that the wells are contaminated with leachate.

Recent studies in the general area of the landfill have revealed widespread contamination of ground water with trace organic compounds, forcing the shutting down of many public supply wells tapping the glacial and underlying aquifers. This problem has ruled out the use of wells in the area for background. The regional contamination problem makes distinguishing individual sources of contamination too difficult.

Pennsylvania

Site PA S-1. The site is located in southeastern Pennsylvania, with the Maryland border forming one of its boundaries. In use since 1970, about one-third of the total 61 ha (150 acres) is filled, using the trench method. Municipal garbage is accepted, plus some reported industrial waste, such as lime, slag, and fly ash. A shoe industry nearby probably contributes

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quantities of dyes, leather trimmings, etc.

The general topography consists of rolling hills. The landfill property is situated on a north sloping hillside, with the entrance and filled areas at the highest site elevations. The majority of the surrounding lands plus completed portions of the landfill are farmed, corn being the principal crop. The monitoring wells are aligned in a broad valley about 0.8 km (0.5 miles) wide. Subsurface geology consists of metamorphic rock (a weathered schist or saprolite) about 30 m (100 ft) in thickness.

The landfill possesses a monitoring well system which satisfies the project criteria. Five wells of 15-cm (6-in.) diameter make up the system. Four of the five wells are placed in monitoring positions with respect to filled areas; the fifth serves as a source of background quality water. Water levels were measured in September 1976, and ranged from about 6.7 to 18 m (22-60 ft) below grade. Well 5 (potable supply) is the deepest (49 m or 160 ft) and reportedly yields 0.38 litre/sec (6 gpm). Wells 1 through 4 are 12, 24, 24, and 18 m (40, 80, 80, and 60 ft) deep, respectively, and generally yield 0.13 to 0.25 litre/sec (2-4 gpm).

Analysis showed that Well 1 produced water with slight contamination; of the hazardous constituents, only cobalt was detected above background at 0.01 mg/l. Iron, calcium, and sodium also were present in concentrations above background.

Site PA S-2. The site contains a municipal incinerator and landfill which serve a large city in southeastern Pennsylvania.

It has been operating since the early 1960's. Municipal wastes and an undetermined quantity of industrial wastes are incinerated and the residue deposited in a lined landfill of about 1.5 ha (3.7 acres). The incinerator process is inefficient, and incomplete combustion results in an excessive volume of residue, which now exceeds the areal limits and capacity of the liner.

The topography of the region is a bedrock highland which steeply slopes to a major river flood plain. The landfill is situated on the edge of the highland, and a sinkhole was observed not far from the pile of incinerator residue. A stream at the foot of the highland bounds the site on three sides. The bedrock geology as determined from well logs and surface features is a transition zone from shales to carbonates. Any leachate escaping the landfill liner would tend to migrate quickly into the carbonate bedrock through solution channels.

Two 15-cm (6-in.) diameter bedrock wells comprise the site's monitoring system. Well 1, located about 198 m (650 ft) from the landfill, serves as a background well. The well is 32 m (105 ft) deep and is cased to a depth of about 12 m (40 ft) below grade; it penetrates shale, limey shale, and limestone. Well 2, about 30 m (100 ft) from the west boundary of the residue fill mound, is 15 m (50 ft) lower than the landfill/incinerator complex and Well 1. Its reported drilled depth is 22 m (73 ft), with the uppermost 7 m (23 ft) cased. The driller's log for Well 2 indicates a limestone aquifer. Static water levels were measured at 21 m (70 ft) and 6 m (20 ft) for Wells 1 and 2, respectively, prior to sampling in December 1976.

Well 2 contained higher concentrations of magnesium, iron, and sodium than Well 1 (background). However, Well 1 contained more sulfate, calcium, and chloride (above the drinking water standards limit) than Well 2. These data suggest that both wells may be affected by leachate, and the results of sampling were inconclusive.

Wisconsin

Site WI S-1. The site is located in east-central Wisconsin, and consists of a privately owned industrial waste lagoon approximately 0.8 ha (2 acres) in area and 9 m (30 ft) deep. It is surrounded by a clay dike and a 1 m (3 ft) thick layer of clay forms its base. An unlined lagoon adjacent to the clay-lined one was utilized prior to 1972. The principal waste product discharged to the lagoon is an acid sludge with a high concentration of aluminum and possibly some heavy metals.

The site is underlain by 6 to 12 m (20-40 ft) of glacial till over highly-weathered limestone. The till is composed primarily of silty clay deposits containing discontinuous stringers and pockets of silt, sand, and gravel. There are 17 monitoring wells finished in the till at depths ranging from 3 to 12 m (10-40 ft) below land surface.

Well 13 is assumed to be upgradient of the waste source and was chosen as the background well. A well on the west side, another well northeast of the lagoon, and Well 13 were sampled in October 1976. The northeast well yielded the most mineralized water, with sulfate, calcium and magnesium having the most elevated concentrations in comparison to background (Well 13).

The sample from the northeast well also contained 0.1 mg/l of barium; barium was not detected in the other wells. No organic substances were detected in any of the samples.

Site WI S-2. The site is located in south-central Wisconsin, and consists of a landfill and several small lined lagoons. The site accepts municipal refuse and mixed industrial waste including plating and clarifier sludges, oils, and solvents. The landfill was a city dump from 1952 to 1972 when a separate toxic and hazardous waste disposal area was constructed in the northwestern corner of the property. Shallow pits were excavated in the old fill and were lined with plastic sheeting that was covered with a layer of fly ash. Liquid industrial wastes are deposited in these pits.

The disposal site is underlain by about 60 m (200 ft) of sand and gravel over limestone bedrock. There are 18 monitoring wells finished in the sand and gravel. Wells P and 6A were selected for sampling because of the probability of their contamination. Well B appeared to be upgradient of the waste and was designated as background.

Water from Well 6A showed contamination from nickel (0.04 mg/l), selenium (0.02 mg/l), and barium (0.1 mg/l). None of these elements were detected in the background sample. No organic contamination was detected in any of the samples.

Site WI S-3. This privately-owned industrial site, located in east-central Wisconsin, has a landfill and a clay slurry settling lagoon. Plating wastes, phenolic resins, and powdered clay are the major waste materials disposed of. Disposal in the landfill area began in 1947. Presently approximately 32 ha (80 acres) have been filled to a thickness of 12 m (40 ft). The clay slurry lagoon is about ten years old, and a seepage pit was in service from 1971 through 1976.

The disposal site is underlain by silty to clayey sand. There are nine monitoring wells finished at depths ranging from 3 to 9 m (10-30 ft) below ground surface. Three wells were selected for sampling, but only Well 5 yielded a sufficient volume of water for analysis. This well is located downgradient of the landfill.

Without background quality data and additional samples, migration of hazardous substances cannot be determined. However, one hazardous element, nickel, was detected at 0.08 mg/l. This element is not commonly detected in natural water.

Site WI S-4. This site, located in southeastern Wisconsin, has a landfill that covers 16 ha (40 acres). The site is permitted to accept industrial liquid and solid wastes. Disposal began in 1971, but no inventory of wastes received is maintained. Liquid and solid wastes are mixed at the working face, and presently have accumulated to an average thickness of 27 m (90 ft).

About 27 m (90 ft) of glacial till overlies dolomite bedrock. The till is composed primarily of sandy to silty clay deposits with pockets of fine sand. Monitoring facilities include 20 wells finished in the till at depths ranging from 6 to 21 m (20-70 ft). Four wells were chosen for sampling, with Well 25 designated as background.

Well 7 contained 0.03 mg/l of arsenic, 0.03 mg/l of selenium, 1.2 mg/l of zinc, all above background. Well 22 contained the same concentration of selenium, 0.24 mg/l of molybdenum, 0.5 mg/l of barium, and 1.2 mg/l of light volatile compounds, all above background.

Site WI S-5. The site is a municipal landfill located in east-central Wisconsin, and accepts industrial wastes from three large manufacturers. Solvents, paint sludges, and degreasing compounds are suspected to be included as waste components. Solid and liquid wastes are mixed during the landfilling operation. The site has been active since 1961, and approximately 24 ha (60 acres) have been covered.

The site is underlain by about 42 m (140 ft) of glacial till over dolomite bedrock. The upper 21 m (70 ft) of till is of sandy clay texture with sand lenses, while the rest is dense blue clay. Monitoring facilities consist of 16 wells finished in the till at depths of about 4.5 to 11 m (15-35 ft) below ground surface. Well E was chosen as a potential background quality well. Well F and a spring were sampled as downgradient monitoring points. Samples were collected in October 1976.

Hazardous constituents above background in the spring water included 0.02 mg/l of selenium, and 0.002 mg/l of unidentified halogenated compounds that were detected in the pesticide analysis. Hazardous constituents in the sample from Well F included 0.02 mg/l of selenium, 0.006 mg/l of cyanide, and 0.06 mg/l of heavy volatile compounds.

Site WI S-6. This site is a large landfill in southeastern Wisconsin which has been active since 1967, and approximately 32 ha (80 acres) have been covered to an average thickness of 21 m (70 ft). The landfill is permitted to accept toxic and hazardous wastes.

The site is underlain by about 37 m (120 ft) of glacial till over dolomite bedrock. Water-supply wells in the area are finished in the bedrock at depths of 53 to 76 m (175-250 ft).

Existing monitoring facilities consist of 14 shallow wells finished in glacial till at depths ranging from 6 to 15 m (20-50 ft) below ground surface. Four wells were chosen for sampling based on their locations relative to the probable path of the leachate plume. Well 2 was assumed to be outside the flow path, and Wells 6 and 7 were assumed to be inside it.

Traces of halogenated compounds, 49.0 mg/l of light volatile compounds, and 0.11 mg/l of heavy volatile compounds were detected in the sample obtained from Well 1. No organic chemicals were detected in water from Well 2. The sample from Well 6 contained 0.03 mg/l of chromium and 0.04 mg/l of selenium, while the sample from Well 7 contained 0.01 mg/l of cyanide.

Site WI S-7. The site is located in west-central Wisconsin and consists of a landfill that accepted municipal waste and industrial waste said to contain lead, zinc, and nickel. The trench method of landfilling was employed, with wastes sometimes being burned openly before being covered. Disposal began in 1969 and continued until July 1976 when the site was permanently closed under orders of the State. The filled area occupies about 1.2 ha (3 acres).

The site is underlain by about 12 m (40 ft) of medium to very fine sand over sandstone bedrock. The sand outcrops in a bluff bounding the eastern edge of the site.

Four monitoring wells finished in the sand at depths ranging from 1.5 to 4.6 m (5-15 ft) below ground surface were sampled in October 1976. Well 4 appeared to be upgradient of the filled area and was designated the background well, but is only 3 m (10 ft) from the disposal area.

All of the wells were contaminated with heavy metals and traces (less than 0.001 mg/l) of PCB-like halogenated compounds. The maximum concentrations of nickel, barium, molybdenum, selenium, and cobalt detected were 0.05, 2.8, 0.04, 0.59, and 0.01 mg/l, respectively. In addition, water from Well 2 contained 12.6 mg/l of light volatile organic compounds, which is above background (none detected). The non-hazardous constituents chloride, iron, and manganese exceeded drinking water limits in one or more samples.

Sampling Results

Extent of Contamination. Physical characteristics of the 50 sampled sites and a summary of the chemical results have been tabulated (Tables 2-3). For 32 sites, monitoring wells already in place were used for sampling. At six of these sites, existing monitoring facilities were found to be incomplete, principally because they did not provide a source of ground water for background quality purposes. In such cases, one or more additional wells were installed to supplement those already in place. At five sites, existing water supply wells were used for monitoring. At the remaining 13 sites, only the wells installed for this project were sampled in the vicinity of the land disposal site, although at a number of these locations, nearby residential or commercial supply wells were used for background.

It should be noted that land disposal sites are surrounded by other sources which also have the potential to add contaminants to ground water, e.g. septic tanks, leaky tanks and sewer lines, spills, agricultural lands receiving fertilizers and pesticides, and highway runoff. Thus, ground water free of some type of degradation is seldom present in urban, industrial, and agricultural areas.

Therefore, four very strict criteria were used to evaluate whether migration of hazardous substances could be confirmed at a particular site and to determine which specific inorganic and/or organic chemicals had migrated at that site. First, one or more hazardous constituents must be detected beyond the boundary

SUMMARY OF SAMPLING RESULTS

DATA FOR MONITORING WELL(S)						DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE I)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
CT S-1	2	Cyanide	0.005	100	17	4	Lead	0.10	1,500	17
		Barium	0.20				Selenium	0.06		
		Arsenic	0.04							
		Lt. volatile org.	1.0							
S-2	1	Mercury	0.0006	150	15					
		Selenium	0.20*							
		Barium	0.10							
		Lt. volatile org.	80.0							
		Halogenated org.	detected							
	2	Halogenated org.	detected	20	20					
		Lt. volatile org.	100.0							
		Copper	0.12							
	3	Halogenated org.	detected	20	25					
		Lt. volatile org.	10.0							
	4	Cyanide	0.02	20	26					
		Lt. volatile org.	1000.0							
		Nickel	0.11							
	5	Copper	0.06	20	20					
		Nickel	0.01							
		Barium	0.10							
		Mercury	0.0005							
		Selenium	0.41*							
		Lt. volatile org.	100.0							
S-3	1	Chromium	0.01	250	12					
		Cyanide	0.007							

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

②

TABLE 5 (Continued)

DATA FOR MONITORING WELL (S)						DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
FL S-1	3	Halogenated org.	detected	50	30					
		Lt. volatile org.	1.8							
		Hvy volatile org.	0.01							
IL S-1	1	Barium	0.10	400	39					
	2	Nickel	0.08	10	22					
		Barium	0.20							
S-2	North	Barium	0.1	1,500	21					
S-3	2	Copper	0.01	300	15					
		Barium	0.20							
S-4	P-6	Barium	0.10	700	35					
S-5	3	Cyanide	0.007	500	52	5	Lead	0.10	2,000	52
	4	Copper	0.01	50	52					
		Chromium	0.01							
		Nickel	0.10							
S-6	2A	Nickel	0.10	90	13					
		Copper	0.01							
		Lead	0.10*							
		Selenium	0.02*							
		Barium	3.80*							
		Halogenated org.	detected							
IN S-1	1	Cyanide	0.008	1,250	apx.145					
		Zinc	0.92							
	3	Cyanide	0.01	650	apx.145					
		Cobalt	0.01							
		Halogenated org.	detected							

*Exceeds EPA Drinking Water Standards (Table 1)

†Feet x 0.305 = metres.

TABLE 3 (Continued)

DATA FOR MONITORING WELL(S)						DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
IN S-2	G-W Seep 1	Chromium	0.01	120	does not apply	G-W Seep 2	Selenium	0.05	600	does not apply
		Arsenic	5.80*							
		Lead	0.30*							
		Cyanide	0.27							
		Hvy volatile org.	0.06							
S-3	Spring	Copper	1.10*	100	does not apply					
		Hvy volatile org.	0.02							
	1	Cobalt	0.03	1,000	apx.70					
S-4	Spring 2	Selenium	0.05*	800	does not apply					
		Barium	0.10							
	3	Halogenated org.	0.003	1,200	160					
S-5	1	Cyanide	0.03	400	unknown					
		Barium	0.20							
	3	Barium	1.10*	200	12					
	5	Halogenated org.	detected	800	10					
		Hvy volatile org.	0.03							
MA S-1		Heavy metals and halogenated compounds detected in water from monitoring well; no background data availab								
S-2	1	Chromium	0.01	20	20	3	Selenium	0.04	400	14
	2	Nickel	0.04	20	13					
		Arsenic	0.65*							
		Barium	0.10							
		Cobalt	0.08							

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

TABLE 3 (Continued)

	DATA FOR MONITORING WELL(S)					DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
MA S-3		Halogenated compounds found in water from monitoring wells; no background data available.								
S-4	1	Chromium	0.01	70	15					
		Nickel	0.05							
		Barium	0.10							
		Selenium	0.08*							
		Lt. volatile org.	1.2							
	3	Selenium	0.13*	1,000	15					
		Lt. volatile org.	15.9							
S-5		Heavy metals and light volatile compounds detected but not above background.								
MI S-1	1	Chromium	0.05	500	75					
		Cyanide	0.63							
	2	Chromium (+6)	0.36*(0.01)	100	66					
		Copper	2.80*							
		Nickel	0.67							
		Cyanide	14.0							
		Mercury	0.0008							
		Selenium	0.08*							
		Molybdenum	0.15							
		Cobalt	0.05							
		Chlor. phenols	detected							
	3	Cyanide	0.35	150	66					
S-2	1	Selenium	0.01	100	90					
		Barium	0.10							
	2	Nickel	0.01	50	90					

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

TABLE 3 (Continued)

DATA FOR MONITORING WELL (S)						DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
MI S-3	1	Nickel	0.03	100	35	3	Zinc	6.1	100	38
		Zinc	31.0*			Note:	Monitoring wells at this site (including Wells 1 and 3) were constructed of galvanized (zinc-coated) well casings.			
		Barium	0.10							
	North	Copper	0.03	300	70					
		Cyanide	0.06							
		Mercury	0.0005							
	Supply	Nickel	0.03	700	120					
S-4	Boiler well	Cyanide	0.01	300	90					
	North	Copper	0.02	150	14					
		Nickel	0.08							
		Cyanide	0.01							
		Selenium	0.01							
		Cobalt	0.17							
S-5	2	Zinc	2.90	100	45					
		Selenium	0.02*							
	3	Copper	0.07	125	50					
		Nickel	0.02							
	4	Cyanide	0.04	75	50					
		Chlor. phenols	0.003							
NH S-1	2	Nickel	0.30	200	40					
		Arsenic	0.12*							
		Selenium	0.03*							
		Barium	0.20							
		Cyanide	0.005							
		PCB's	0.002							
		Lt. volatile org.	15.3							
		Hvy volatile org.	0.25							

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

TABLE 3 (Continued)

DATA FOR MONITORING WELL(S)						DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
NH S-1	3	Selenium	0.25*	250	16					
		Lt. volatile org.	28.0							
S-2	1	Selenium	0.03*	50	10					
		Barium	0.10							
		Halogenated org.	detected							
	2	Selenium	0.09*	50	6					
		Barium	0.10							
		Halogenated org.	0.002							
		Lt. volatile org.	171.4							
NJ S-1 Boring										
	1	Chromium	0.15*	50	48	1	Selenium	0.04	950	80
		Copper	0.81							
		Zinc	240.0*							
		Cobalt	0.04							
		Halogenated org.	0.003							
	3	Copper	0.01	500	45					
		Zinc	4.80							
		Selenium	0.02*							
S-2	1	Copper	0.01	300	79	2	Selenium	0.22	400	60
		Nickel	0.20							
		Zinc	0.06							
		Barium	0.10							

* Exceeds EPA Drinking Water Standards (Table 1)
† Feet x 0.305 = metres.

TABLE 3 (Continued)

	DATA FOR MONITORING WELL(S)					DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
NJ S-3	1	Cyanide	0.05	180	40					
		Toluene	detected							
		Xylenes	detected							
		Alkyl benzenes	detected							
		Benzene	detected							
	2	Toluene	detected	380	26					
		Xylenes	detected							
	3	Lead	19*	215	24					
		Toluene	detected							
		Xylenes	detected							
		Alkyl benzenes	detected							
		Butyl alcohol	detected							
		Methyl ethyl ketone	detected							
		Camphor	detected							
		Naphthalene	detected							
		Benzene	detected							
	4	Xylenes	detected	300	28					
	5	Xylenes	detected	90	18					
		Methyl ethyl ketone	detected							
S-4	1	Nickel	0.07	120	53	3	Selenium	0.10	850	19
		Selenium	0.24*							
	2	Chromium	420.0*	100	20					
		Halogenated org.	detected							
		Lt. volatile org.	200.0							
S-5	1D	Mercury	0.006*	1,150	55	2	Selenium	0.05	50	45
	1S	Halogenated org.	0.005	1,150	12					

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

TABLE 3 (Continued)

	DATA FOR MONITORING WELL (S)					DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE I)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
NJ S-6	1	Zinc	0.36	600	40					
		Selenium	0.02*							
	2	Zinc	0.40	300	4					
		Barium	0.60							
		Selenium	0.01							
		Halogenated org.	detected							
		Lt. volatile org.	4.1							
S-7		Heavy metals and halogenated compounds detected but not above background.								
S-8	8	Chromium	0.01	450	47					
		Copper	0.01							
		Selenium	0.01							
		Barium	0.20							
		Cobalt	0.04							
		Lt. volatile org.	386.9							
		Hvy volatile org.	0.59							
S-9	1	Chromium	0.01	300	156					
		Copper	0.04							
		Nickel	0.07							
		Zinc	0.40							
		Cobalt	0.22							
		Lt. volatile org.	0.3							
	2	Zinc	0.38	100	280					
		Cobalt	0.07							
		Trichloroethylene	0.3							
	3	Copper	0.17	200	267					
		Zinc	0.59							
		Cobalt	0.05							
		Trichloroethylene	0.2							

*Exceeds EPA Drinking Water Standards (Table 1)

†Feet x 0.305 = metres.

TABLE 3 (Continued)

DATA FOR MONITORING WELL(S)						DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
NY S-1	1	Zinc	0.01	400	52					
		Halogenated Org.	detected							
	Spring	Copper	0.10	75	does not apply					
		Halogenated Org.	0.006							
		Heptachlor	detected							
S-2	4	Barium	0.50	750	14					
	Spring box	Copper	0.05	500	does not apply					
		Selenium	0.01							
	Res. mon. well	Copper	0.03	750	20					
S-3	2	Cyanide	0.008	50	14					
		Halogenated org.	detected							
		Hvy volatile org.	0.23							
	3	Selenium	0.02*	800	25					
S-4	1	Barium	0.10	2,000	70					
		Cobalt	0.01							
		Halogenated org.	detected							
	3	Barium	0.10	50	65					
		Cobalt	0.01							
		Halogenated org.	detected							
S-5		Heavy metals, halogenated compounds, and light volatile compounds detected but not above background.								

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

TABLE 3 (Continued)

	DATA FOR MONITORING WELL(S)					DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
PA S-1	1	Cobalt	0.01	300	40					
S-2		Heavy metals detected but not above background.								
WI S-1	NE	Barium	0.10	150	apx.35					
S-2	6A	Nickel Selenium Barium	0.04 0.02* 0.10	30	95					
S-3		Heavy metals detected in water from monitoring well; no background data available.								
S-4	22	Selenium Molybdenum Barium Lt. volatile org.	0.03* 0.24 0.50 1.2	80	unknown					
	7	Arsenic Selenium Zinc	0.03 0.03* 1.20	500	39					
S-5	F	Selenium Cyanide Hvy volatile org.	0.02* 0.006 0.06	200	apx.16					
	Spring	Selenium Halogenated org.	0.02* 0.002	300	does not apply					
S-6	1	Halogenated org. Lt. volatile org. Hvy volatile org.	detected 49.0 0.11	500	44	2	Selenium	0.02	100	41

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

TABLE 3 (Continued)

	DATA FOR MONITORING WELL(S)					DATA FOR BACKGROUND WELL (S)				
STATE and SITE	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE BACKGROUND	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†	WELL NUMBER	HAZARDOUS CONTAMINANTS ABOVE DRINKING WATER STANDARDS (TABLE 1)	CONCENTRATION (mg/l)	DISTANCE FROM DISPOSAL AREA (FEET)†	TOTAL DEPTH (FEET)†
WI S-6	6	Chromium Selenium	0.03 0.04*	75	30					
	7	Cyanide	0.01	100	35					
S-7	1	Barium Cobalt	2.8* 0.01	70	18	4	Selenium	0.10	20	44
	2	Selenium	0.59*	230	24					
	3	Barium Cobalt	0.40 0.01	50	26					

*Exceeds EPA Drinking Water Standards (Table 1)
†Feet x 0.305 = metres.

of the waste deposition area. Second, the concentration of a hazardous substance must exceed the concentration of the same substance in water from a background well or other background ground-water source. Third, all wells used to evaluate a site must tap the same aquifer. Finally, based on an interpretation of geohydrology and overall ground-water chemistry, the data must identify the landfill or lagoon under study as the source of the inorganic or organic substance. Final analysis and review of hydrogeologic and chemical data from the 50 sampled sites has led to minor modification of the number where migration of hazardous substances has occurred as presented in the two preliminary progress reports (Project Synopsis, dated February 24, 1977, and Interim Project Report, dated April 15, 1977). Modifications have resulted from applying the most stringent criteria and conservative approach to analysis of the completed data base.

At 43 sites, migration of one or more hazardous constituents was confirmed. At four other sites, although background wells had been chosen, the areal extent of ground water containing hazardous substances was greater than expected, or ground-water movement was not in the direction assumed during the field inspection prior to drilling and/or sampling. Contamination by heavy metals and/or organic chemicals was detected at these four sites, but concentrations in water from background wells were either equal to or greater than concentrations in water from the other monitoring wells. At three sites, background data were not available because of the inability to obtain water from wells that had previously been chosen for background. However, again, contamination with hazardous constituents was found in the monitoring wells sampled at these three sites.

Organic contaminants were detected at 40 of the 50 sites. Because most analyses were made by gas chromatography alone, individual organic compounds were not always identified. At 27 sites, migration of organic chemicals was confirmed according to the strict project criteria. At 13 sites, although organic compounds were detected in ground water, the landfill or lagoon under study could not be clearly identified as the source of contamination. Where this occurred, the site was ruled out as one at which organic substances had migrated. Using similar criteria, heavy metals, excluding iron and manganese, were found to be present at 49 sites and were confirmed to have migrated at 40 sites. Selenium, arsenic, and/or cyanide were found to be present at 37 sites, and were confirmed to have migrated at 30 sites. In all, 86 wells and springs yielded water containing one or more hazardous substances with concentrations above background. In other words, 74 percent of the wells and springs not used for background quality confirmed migration of hazardous substances.

There were four sampled sites, all landfills, that included engineering features designed to control leachate, such as liners and leachate recirculation systems. One site showed no contamination above background. At another site, one hazardous constituent was detected above background, but at a low concentration. The third facility showed severe organic contamination, but the site inspection revealed that only a small portion of the leachate is intercepted by the liner and recirculated. At the fourth site, cyanide and three heavy metals were found above background. However, waste disposal is to trenches, the bottoms of which are lined but not the sides.

One of the study criteria was that contamination by hazardous substances must be detected outside of the boundary of waste deposition. This was to insure that the hazardous substance had already migrated away from the site. Thus, the potential for further migration is demonstrated. The distance of wells where the migration of hazardous substances was confirmed ranged from 3 m (10 ft) to more than 300 m (1,000 ft) from the disposal area. Heavy metals, organic compounds, and other constituents defined as hazardous have been detected at above-background concentrations in wells farther from 300 m (1,000 ft) from the source. The depths of such wells ranged from less than 3 m (10 ft) to 49 m (160 ft).

Data are not available to compare the mobility of one constituent versus another. To accomplish this, wells must be located directly along flow lines. They must also be screened at depths where comparable flow conditions exist. Samples must be collected periodically to establish the relationship of time, distance of travel, and constituent concentration. Discharge of leachate from landfills is dependent upon intermittent periods of recharge from precipitation, which produces "slugs" of contamination. Chemical characteristics of industrial waste effluent entering leaky lagoons can vary as manufacturing processes change. Such factors confound the relationship of distance and concentration.

Only 20 percent of the sites inspected and sampled were located in areas underlain by natural sediments of low permeability (Tables 2 and 4). This is because older facilities were studied, and criteria for siting in more favorable geohydrologic environments have only recently become of universal high priority. Many of the less severe instances of ground-water contamination were found at sites in areas of low permeability. However, a much larger number of facilities and more detailed sampling at each would be required to develop a quantitative evaluation of comparative geologic settings.

Quality of Contamination. In all, 12 hazardous inorganic constituents were detected above background concentrations in water from the monitoring wells. The five most frequently occurring were selenium, barium, cyanide, copper, and nickel in that order. The elements occurring least frequently above background were lead, mercury, and molybdenum.

There are many complexities surrounding the frequency with which potentially hazardous constituents may be detected in leachate-contaminated ground water. Briefly, these include the chemical form and total amount of the constituents in the waste, interaction of the constituents with co-deposited wastes, the attenuation capability of underlying geologic materials, susceptibility of the constituents to adsorption or other attentuation, and the interaction between the constituents and the

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ground-water system. Predicting the behavior of contaminants from a known waste being placed in a heterogeneous waste disposal environment is not possible without considerable drilling and sampling in the general area of the disposal site.

However, based on the limited knowledge available about waste materials and geology at the study sites, it is possible to interpret the data in a general way. For example, a number of sites were reported to accept electronics industry waste. Selenium metal is used by this industry. Several sites were reported to accept pigments and paint wastes, of which barium is a common component. Cyanide is an important component of metal plating and pickling processes, so cyanide would be expected in process wastes that were reported to be disposed of at several sites. Likewise, copper and nickel could come from metal plating wastes. Selenium, barium, cyanide, copper, and nickel were commonly found in ground waters associated with sites receiving wastes of these types.

Some correlations between organic wastes and organic contaminants appear valid. PCB's were identified at two sites known to have PCB's in the waste. Organic solvents (volatile organic compounds) were detected at a lagoon site known to have alcohol and ketone solvents in the waste. A large number of organic compounds were identified at one site with the assistance of the EPA Edison, New Jersey, laboratory. Gas chromatographic/mass spectrometric analysis showed the presence of toluene, xylenes, benzene, and alcohols, among other organic compounds. This site had received large quantities of solid, liquid, and sludge wastes for many years from waste generators in surrounding States.

Degree of Contamination. A major problem in estimating the degree of contamination is lack of a clear definition of the health significance relating to some of the potential toxicants encountered in the study. A number of the inorganic substances used as contamination indicators are included in the EPA drinking water standards (Table 1). The drinking water standards also include some organic compounds under the categories of halogenated and phenoxy pesticides.

If ground water is degraded in respect to drinking water standards, then the degree of degradation can be compared to some existing criteria. At 26 sites, hazardous inorganic constituents in water from one or more monitoring wells exceeded the EPA drinking water limits. Of the hazardous substances, selenium most frequently exceeded drinking water limits, followed by arsenic, chromium, and lead. Although analyzed for, halogenated pesticides, presently included in EPA drinking water standards, were not found. Organic substances that were identified in water from monitoring wells included PCB's, chlorinated phenols, benzene and derivatives, and organic solvents. At least some of these organic chemicals may be listed in future standards as a result of EPA sponsored research by the National Research Council. 12)

Hazardous inorganic constituents exceeded drinking water limits in a background well at 10 sites. Again, selenium was the element most frequently exceeding the limit. Two other constituents that exceeded the limits were lead and zinc. Several background wells had detectable quantities of organic compounds, but none were identified that are included in drinking water standards.

It should be noted that the drilling and sampling carried out for this project was not directed at locating the most severely contaminated zone at any particular site. Use was made, where possible, of existing monitoring wells, which were probably not placed in the best location for intercepting the most severely degraded ground water. At drilled sites, substantially more than the small number of wells installed to confirm migration would have been required to map the plume of contaminated ground water and to select the most adversely affected zone. A network of a minimum of 25 and perhaps as many as 50 wells would be needed for such a study, along with the appropriate sampling. The estimated number of wells is high because they would have to be drilled over a broad area and to several depths at each monitoring location.

Descriptions of Sites Inspected but Not Sampled

Industrial waste disposal facilities located from New Hampshire to Florida and as far west as California were inspected as part of the site selection process (Table 4). The facilities included in the inspections were chosen on the basis of data provided by the cooperating State agencies. Inspections were made to confirm the accuracy of information on file, to observe the physical and geologic conditions at the site, to assure that the site met the criteria of the project, and to select sampling locations. Fifty of the sites inspected were subsequently sampled and have been described in a previous section. Of the remaining 72 sites, 28 already contain monitoring wells and seven have liners and/or leachate control systems.

The geological settings of the inspected sites were as follows: flood plain 14 percent, shallow bedrock 15 percent, glaciated 35 percent, and coastal plain 36 percent. About 20 percent of the sites were located in areas of low permeability, whereas 17 percent were located in abandoned sand pits or quarries.

A variety of waste materials and facility types were included among the inspected sites. Facilities included lagoons, landfills, and combinations of the two. Sites range in age from 2 to over 30 years. Eighteen abandoned sites were included because they may continue to contaminate ground water long after being closed.

TABLE 4

SUMMARY OF DATA FROM SITES INSPECTED BUT NOT SAMPLED

State and site		Location in state*	Geologic setting	Age (yrs)	Facility type	Reported waste types received	Monitored	Active	Reason for rejection
Alabama	1-1	NC	Shallow bedrock - carbonate	12	Landfill	Organic liquids			Project termination
	1-2	NC	Coastal plain - clay	14	Landfill ‡	Inorganic solids & liquids			Project termination
	1-3	NC	Coastal plain - sand	3	Landfill	Inorganic solids		✓	Project termination
	1-4	EC	Flood plain	5	Lagoon	Organic liquids		✓	Project termination
	1-5	SC	Coastal plain - sand	4	Landfill	Organic liquids & inorganic sludges		✓	Project termination
	1-6	SW	Coastal plain - sand	7	Lagoon†	Organic sludges		✓	Project termination
	1-7	SW	Coastal plain - sand	4	Landfill	Unknown		✓	Small waste volume
	1-8	NC	Shallow bedrock - carbonate	2	Landfill	Inorganic sludges		✓	Too young
California	1-1	WC	Coastal plain	4	Landfill & lagoon	Organic & inorganic liquids	✓	✓	Project termination
	1-2	WC	Coastal plain	<5	Lagoon	Organic liquids	✓	✓	Project termination
Connecticut	1-1	SW	Glaciated area - clay	<10	Landfill	Organic & inorganic liquids		✓	No access
	1-2	SW	Glaciated area - clay	<10	Landfill	Unknown		✓	No access
	1-3	S	Flood plain	<10	Lagoon	Organic liquids		✓	No access
Illinois	1-1	SW	Flood plain	10	Landfill	Organic liquids	✓	✓	No access
	1-2	NE	Glaciated area - clay	13	Landfill	Inorganic sludges & organic liquids	✓	✓	Poor records
	1-3	NE	Glaciated area - clay	3	Landfill	Inorganic sludges	✓	✓	No geologic control
	1-4	NC	Glaciated area - sand	9	Landfill †	Inorganic solids & liquids	✓	✓	Small waste volume
	1-5	NE	Glaciated area - clay	8	Landfill	Inorganic sludges & organic liquids	✓	✓	Small waste volume
	1-6	NE	Glaciated area - clay	8	Landfill	Organic & inorganic solids & liquids	✓	✓	Poor records
	1-7	NE	Glaciated area - clay	7	Landfill	Inorganic sludges	✓	✓	No access
	1-8	EC	Shallow bedrock - shale	?	Landfill	Organic liquids			Project termination
	1-9	NC	Shallow bedrock - shale	14	Landfill	Inorganic sludges & organic liquids	✓	✓	Project termination
Indiana	1-1	NC	Flood plain	8	Landfill	Inorganic solids		✓	No access
	1-2	SW	Strip-mined area	6	Lagoon	Inorganic sludges		✓	Project termination
	1-3	EC	Flood plain	>10	Landfill†	Unknown			In litigation
	1-4	EC	Glaciated area - sand	5	Landfill	Inorganic sludges	✓	✓	Too young
	1-5	EC	Flood plain	6	Landfill	Organic solids			Project termination
	1-6	EC	Glaciated area - sand	3	Landfill	Inorganic sludges & organic liquids		✓	Too young
	1-7	NW	Glaciated area - clay	11	Landfill	Inorganic sludges & organic liquids		✓	Project termination
	1-8	EC	Glaciated area - clay	4	Landfill	Inorganic sludges & organic liquids	✓	✓	Too young
	1-9	NE	Glaciated area - clay	>10	Landfill	Unknown	✓	✓	Poor records
Massachusetts	1-1	NC	Glaciated area - sand	<10	Lagoon †	Organic liquids		✓	No access
	1-2	SC	Glaciated area - sand	<10	Landfill †	Inorganic sludges		✓	Poor records
Michigan	1-1	EC	Glaciated area - sand	3	Landfill †	Inorganic sludges		✓	Project termination
	1-2	NC	Glaciated area - sand	19	Lagoon	Inorganic liquids		✓	Project termination
	1-3	SE	Glaciated area - sand	9	Lagoon †‡	Organic liquids	✓	✓	No geologic control
	1-4	SE	Flood plain	>10	Lagoon	Inorganic sludges		✓	No access
	1-5	EC	Flood plain	>10	Landfill	Organic solids		✓	No access
Mississippi	1-1	SW	Coastal plain - sand	2	Lagoon	Unknown	✓	✓	Project termination
	1-2	WC	Coastal plain - sand	10	Lagoon †	Inorganic liquids			Project termination
	1-3	NC	Coastal plain - sand	5	Landfill & lagoon	Unknown		✓	Project termination
	1-4	NE	Coastal plain - sand	4	Landfill	Organic sludges		✓	Project termination

TABLE 4 (Continued)

State and site		Location in state*	Geologic setting	Age (yrs)	Facility type	Reported waste types received	Moni-tored	Active	Reason for rejection
Mississippi	1-5	EC	Coastal plain - sand	>10	Landfill	Organic liquids			Poor records
	1-6	WC	Coastal plain - sand	>10	Landfill	Unknown			Poor records
	1-7	WC	Flood plain	>10	Landfill	Unknown			Poor records
	1-8	WC	Flood plain	>10	Landfill	Unknown			No access
	1-9	EC	Coastal plain - sand	2	Landfill	Unknown		✓	Small waste volume
	1-10	NC	Coastal plain - sand	>10	Landfill	Unknown			Poor records
New Hampshire	1-1	S	Glaciated area - sand	<10	Lagoon	Organic liquids		✓	No access
	1-2	S	Glaciated area - clay	>10	Landfill	Inorganic sludge		✓	Poor records
New Jersey	1-1	SW	Coastal plain - clay	>10	Landfill	Inorganic solids	✓	✓	Damage case
	1-2	SW	Coastal plain - sand	>10	Landfill‡	Inorganic liquids	✓	✓	Damage case
	1-3	SW	Coastal plain - sand	>10	Landfill & lagoon	Unknown	✓	✓	Small waste volume
	1-4	SW	Coastal plain - sand	>10	Landfill‡†	Organic & inorganic liquids	✓	✓	Damage case
	1-5	SW	Coastal plain - sand	>10	Landfill	Unknown			Poor records
	1-6	SW	Coastal plain - sand	>10	Landfill	Inorganic sludge	✓	✓	Project termination
	1-7	SW	Coastal plain - sand	>10	Landfill	Inorganic solids	✓		Damage case
	1-8	SW	Coastal plain - sand	>10	Landfill ‡	Unknown	✓		Poor records
New York	1-1	NW	Shallow bedrock - carbonate	7	Landfill ‡	Organic & inorganic solids, liquids & sludge	✓	✓	No access
	1-2	NE	Glaciated area - sand	7	Landfill & lagoon †‡	Organic & inorganic sludges	✓	✓	Poor records
	1-3	NE	Glaciated area - sand	5	Landfill†‡	Organic liquids		✓	Poor records
Pennsylvania	1-1	SE	Shallow bedrock - shale	<10	Landfill	Unknown	✓	✓	Poor records
South Carolina	1-1	NW	Shallow bedrock - crystalline	5	Lagoon	Inorganic sludges & organic liquids			Project termination
	1-2	EC	Coastal plain - sand	2	Landfill	Organic liquids	✓		Project termination
	1-3	SE	Coastal plain - sand	5	Landfill	Inorganic sludges & organic liquids	✓	✓	Project termination
	1-4	EC	Coastal plain - sand	6	Landfill	Inorganic sludges & organic liquids			Project termination
	1-5	NW	Shallow bedrock - crystalline	>30	Landfill	Organic sludges		✓	No geologic control
	1-6	NW	Shallow bedrock - crystalline	1	Landfill	Organic liquids	✓	✓	Too young
	1-7	EC	Shallow bedrock - crystalline	2	Lagoon	Organic & inorganic liquids		✓	Too young
Wisconsin	1-1	EC	Shallow bedrock - carbonate	7	Landfill	Organic liquids & solids			No geologic control
	1-2	EC	Glaciated area - sand	26	Landfill	Inorganic sludges			No geologic control
	1-3	EC	Glaciated area - sand	?	Landfill †	Organic liquids		✓	No geologic control

* Location in state: N = north, S = south, E = east, W = west, C = central

† Facility located in abandoned sand and gravel or limestone quarry.

‡ Facility engineered with some type of leachate control such as liner, underdrain, or recirculation.

< Means "less than"

> Means "greater than"

Alabama

Site AL I-1. The site, located in north-central Alabama, was operated as an open dump and then as a sanitary landfill, before its forced closure in 1973 by State regulatory authorities because of recurrent incidents of surface-water contamination originating from the property. Large but unknown quantities of industrial liquids, sludges, and solids have reportedly been disposed of at the site, specifically ethylene glycol, terephthalic acid, dimethylterephthalate, and cutting oils. The disposal grounds overlie a permeable limestone formation with sinkholes and a major fault zone. No ground-water monitoring is carried out at this site, although several springs drain the area. Early project termination prevented sampling of these ground-water discharge points as a part of the project.

Site AL I-2. This site, in north-central Alabama, was operated as a dump from 1957 to 1960 and then as a sanitary landfill. A permit to operate was never issued by the state and the site was abandoned in 1971. Metal processing wastes including liquids, sludges, and solids were accepted from 1960 to 1971. A leachate collection tile system was installed within the facility in about 1970 to eliminate leachate springs in the downgradient part of the fill. Leachate intercepted by the underdrains was diverted to a municipal sewage treatment plant for dilution and subsequent discharge to an adjacent river. The geology of the site is uncertain. The uppermost earth materials exposed in a borrow pit along the flank of the filled area are predominantly dense clays intermixed with angular chert boulders of various sizes. Dense crystalline bedrock is believed to lie at a shallow depth below this formation. Proposed sampling of observed leachate seep springs along the toe of the fill, and the installation of two wells for sampling ground water upgradient and downgradient from the site, were cancelled because of early project termination.

Site AL I-3. This open dump in northern Alabama is owned and operated by an industry which recycles used batteries. The refuse it receives consists of lead smelting waste and unreclaimed battery parts. Any subsurface migration of contamination from the disposal grounds is believed to enter an underlying sand and gravel formation and flow from there to a nearby creek. Two monitoring wells planned for installation at appropriate upgradient and downgradient locations within the adjacent stream flat were not constructed because of early project termination.

Site AL I-4. This site is located in east-central Alabama. The disposal operation uses an unlined lagoon to receive wash water from railroad tank car cleaning operations. The variety of waste products is wide because of the diversity of materials carried in the tank cars. Substances entering the lagoon include styrene, fertilizer solutions, pesticides, mineral acids, industrial solvents, and many other liquid chemical products. The lagoon is finished in the clayey upper portion of a 15-to 30-m (50-to 100-ft) thick formation of alluvial clay, silt, sand, and gravel. Underground migration of any contamination which might originate from this site is believed to be toward an adjacent creek and a wash water supply well located about 30 m (100 ft) away from the car cleaning yard. A 1975 chemical analysis of water from this 14-m (48-ft) deep supply well revealed no contamination. A background well in the same geohydrologic unit is located at an active gravel pit about 0.62 km (one mile) away. Sampling of these facilities, and the installation and sampling of an additional monitoring well between the waste lagoon and the creek was not possible before the project was terminated.

Site AL I-5. The site is located in south-central Alabama, and has three pits, each 9 m (30 ft) wide, 6 m (20 ft) deep, and 380 m (1,250 ft) long. Trench disposal of domestic and industrial waste began in 1973. Hazardous wastes include pentachlorophenol, mercury-treated cottonseed (several million pounds), and heavy metal alkali and acid sludges. The Alabama Geological Survey reports that the site is underlain by red clayey sand and sandy clay of unknown thickness. A well supplying water for the landfill operation is located upgradient of the disposal trenches. During the site inspection, two springs were noted along the bank of a small creek which flows on the eastern edge of the disposal grounds about 30 m (100 ft) from the filled area. A shallow monitoring well planned for installation between the oldest trench and the creek was to be sampled at the time that water samples from the springs and supply well previously mentioned would be obtained. The project was terminated before this work could be done.

Site AL I-6. The site is located in the southwestern corner of Alabama. A series of lagoons located in a large sand borrow pit receives about 303,800 litres (80,000 gal.) of used oil each month for extraction of water. The water and oil sludge mixture from tank trucks is emptied into the unlined lagoons where the water component seeps into underlying sand formations. The water lost to underlying formations carries with it impurities from the oil that may include certain heavy metals and organic compounds. Geologic deposits of the area are generally sandy in nature, but locally contain lenses of clay. Beneath the unconsolidated deposits is a sandstone formation, estimated to be about 30 m (100 ft) below land surface. Had the project not been terminated earlier than planned, one monitoring well would have been installed at a location about 30 m (100 ft) downgradient from the oldest lagoon for contamination detection sampling, and an upgradient domestic well in the area would have been sampled for background.

Site AL I-7. The site, in southern Alabama, consists of a trench landfill. During inspection, the operator reported that the site had received no more than a few thousand gallons of liquid industrial wastes. For this reason, the site was not considered for further study.

Site AL I-8. The site is located in north-central

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Alabama, and is a three-year old landfill. Large volumes of heavy metal sludges have been disposed of at the site. However, the short time of operation, and the impermeable nature of surficial earth materials underlying the site, practically assure that no appreciable ground-water contamination has had time to migrate beyond the disposal grounds.

California

Site CA I-1. This site is located northeast of San Francisco and consists of a network of evaporation ponds, landfills, and landspreading areas for the disposal of industrial hazardous waste (as defined by the State of California). The site covers over 81 ha (200 acres) along the sides and bottom of a watershed. Over 8 million litres (2 million gal.) of liquid wastes are received monthly. A monitoring well network is installed, but no data were available at the time of inspection.

Site CA I-2. The disposal site is located northeast of San Francisco. A facility for solvent recovery and incineration, and a land disposal area for other types of industrial wastes are located here. The land disposal facility has both lagoons for liquid and sludge disposal, and areas where wastes are landspread. A monitoring well network has been installed by the site owners; however, no data were released at the time of inspection.

Connecticut

Site CT I-1. This 12-ha (30-acre) privately owned landfill is located in southwestern Connecticut, about 2.4 km

(1.5 mile) east of a moderately-sized river. All types of wastes are accepted and industrial materials are known to constitute a major portion of the total volume of waste material received. Ground-water data were not available; however, leachate-contaminated surface water has shown positive heavy metal test results, and PCB's are suspected. The area is underlain by glacial deposits, with sand and gravel occurring in narrow valleys and a thin till covering on hills. During inspection in September 1976, ground water was estimated to be 4 to 6 m (15-20 ft) below ground surface.

The inspection revealed no suitable monitoring sites within the landfill property which were accessible to drilling equipment. This fact, plus difficulties in securing access across neighboring properties, prevented further field study of the site.

Site CT I-2. The site, in southwestern Connecticut, is located on top of a hill on bedrock, about 1.6 km (1 mile) west of a major river. About 12 ha (30 acres) in area, it accepts a wide variety of municipal and industrial wastes. During an inspection of the site in September 1976, numerous small streams, originating as small springs issuing from the hillside, were observed, and surface waters near the site showed indications of leachate contamination. These are the most probable means for leachate transport from the site. No monitoring wells exist.

Due to the complexity of the hydrologic system, the lack

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of a suitable aquifer medium for ground-water transport, and problems with private property access, no further action was taken.

Site CT I-3. This industrial site is located in southern Connecticut near a major estuary. It consists of three waste lagoons situated on tidal marsh land adjacent to an interstate highway. The principal material contained in the lagoons is dimethylsulfoxide (DMSO), a volatile organic compound known for its ability to penetrate living tissue through surface contact. This site could not be used for sampling purposes during the project because access was denied by the owners.

Illinois

Site IL I-1. This site is located in southwestern Illinois, and is a landfill receiving municipal refuse and industrial and sewage sludges. Disposal began in the mid 1960's; in 1972 the site was developed into a sanitary landfill. The site is situated on an island created by a barge canal which parallels a river. Available soil boring data indicate that the area is underlain by more than 15 m (50 ft) of alluvial sand, silt, and silty clay. There are five monitoring wells finished in the alluvium at depths averaging 9 m (30 ft) below ground surface. Considering the potential for movement of contaminants in ground water through the alluvial earth materials, it was determined that additional monitoring wells would have to be installed because the existing wells were located too far away from the fill to assure early detection of contaminant migration. This site

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was eliminated from the sampling phase of the study because of access problems.

Site IL I-2. The site is located in northeastern Illinois, and is a 24-ha (60-acre) landfill. Hazardous waste consisting of oil, paint, and heavy metal sludges have been accepted since the late 1960's. The site is underlain by about 27 m (90 ft) of silty, clayey till with intermittent sand and gravel lenses over fractured dolomite bedrock. There are six monitoring wells finished in a sand and gravel zone above the bedrock surface. By placing all of the wells in this deep aquifer, the possibility of migration through any shallow sand zone which may persist laterally beneath the site was not fully investigated. Also, two of the wells appear to have been drilled through waste material of the older fill. It was determined that additional wells would have to be installed to provide adequate water-quality data for background and detection purposes. The site was eliminated from further evaluation.

Site IL I-3. The site is a municipal and industrial land fill located in northeastern Illinois. Hazardous components of waste include industrial wash-down water, caustic and acidic sludges, and heavy metals. These have been disposed of at the site since 1973. Geologic data indicate that the site is underlain by 24 to 36 m (80-120 ft) of silty, clayey till with sand and gravel lenses over fractured dolomite bedrock. Existing monitoring facilities consist of three pairs of monitoring wells, with a shallow well averaging 17 m (55 ft) in depth and

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a deep well averaging 27 m (90 ft) in depth at each location. This site was eliminated from the sampling phase of the project because insufficient information was available to determine the water-table gradient and the adequacy of the existing monitoring wells.

Site IL I-4. The site is located in north-central Illinois, and consists of a 16-ha (40-acre) landfill. An abandoned gravel pit near the edge of the active site was filled as part of the original disposal operations, which began in the late 1960's. Hazardous waste has been accepted since 1971, and includes industrial sludges and liquids generated by small local industries. The site is underlain by about 9 m (30 ft) of glacial silt, sand, and gravel over fractured dolomite bedrock. Six monitoring wells are present and are finished in the glacial material. This site was eliminated from the sampling program after it was determined that relatively small quantities of hazardous waste (in comparison to municipal refuse) had been disposed of in the fill.

Site IL I-5. This site, a 64-ha (160-acre) landfill, is located in northeastern Illinois. Industrial wash-down water and treated sludges containing small amounts of heavy metals comprise the hazardous waste input. These materials have been disposed of since the late 1960's. Soil boring data indicate that the area is underlain by 1.5 to 9 m (5-30 ft) of silty clayey till, with sand and silt lenses, over fractured dolomite bedrock. The four monitoring wells present are finished in the till. The site was eliminated because of the small volume of hazardous wastes.

Site IL I-6. The site is located in northeastern Illinois, and consists of a 68-ha (170-acre) landfill. Municipal refuse, oils, paint sludges, solvents, and a variety of caustic and acidic liquid wastes are accepted. Industrial wastes are also shipped in from out of state. Soil boring information indicates that the area is underlain by about 6 m (20 ft) of lacustrine sand and silt above 21 m (70 ft) of glacial till, which in turn overlies fractured dolomite bedrock. Five monitoring wells are finished in the lacustrine and glacial materials at depths ranging from 3 to 17 m (10-55 ft) below ground surface. Since the possibility exists that some or all of the existing monitoring wells penetrate fill material, it was determined that additional wells would be needed to provide representative background and detection water quality data. Thus, the site was not sampled.

Site IL I-7. The site, located in northeastern Illinois, is a 12-ha (30-acre) landfill containing municipal refuse, oils, paint sludge, and sludges containing heavy metals. Geologic data indicate that the area is underlain by about 6 m (20 ft) of lacustrine clay, 12 m (40 ft) of clayey till, and fractured dolomite bedrock. Four pairs of monitoring wells exist at the site, with a shallow well finished 6 to 9 m (20-30 ft) below ground surface and a deep well finished 21 to 27 m (70-90 ft) below ground surface at each well location. No sampling was done because the landfill operator refused access.

Site IL I-8. The site is located in east-central Illinois, and is now an abandoned 20-ha (50-acre) landfill. A single burial of an unknown quantity of herbicide took place in the northeast corner of the landfill. Other industrial wastes from the region have also been mixed with municipal wastes and deposited. The site is situated in an abandoned strip mine area, and, although no monitoring wells are present, a leachate seep near the herbicide burial location was noted. It was determined that this site could be studied by sampling the seep for detection purposes and inventorying a local water supply well for background water quality. These plans were not carried out due to early project termination.

Site IL I-9. The site is located in north-central Illinois, and consists of a 24-ha (60-acre) landfill. Dumping began in the early 1960's, but the site was not upgraded to a sanitary landfill until 1973. Engineering data and topographic maps indicate that the area is a former strip mine located on a river bluff. Approximately 11 m (35 ft) of overburden was stripped to mine a coal seam. Beneath the coal seam, a clay layer averaging 1.5 m (5 ft) in thickness was left by the stripping operation. The shale overburden was piled on top of the clay as the mining progressed. Four monitoring wells are finished in the spoil material, but three of them have been dry, according to the records. Two seep springs which could be sampled for background and detection were located during field inspection, although the project was terminated before sampling could be carried out.

Indiana

Site IN I-1. The site is located in north-central Indiana. Metal smelting waste (dross) containing high concentrations of chloride and fluoride has been disposed of directly on the land surface since the late 1960's. Geological records indicate that the site is underlain by 1.5 to 6 m (5-20 ft) of clay residual soil over dense limestone bedrock. The site is situated on an upland at the edge of a limestone bluff. In the river valley below the bluff, alluvial sands and gravels are present from the land surface down to bedrock, a depth of 9 to 15 m (30-50 ft). Precipitation runoff from the dross piles contains chloride and fluoride, and presents the major source of pollution at the site. A large portion of this runoff flows overland down the bluff, percolates into the alluvium and reaches the water table. Since no monitoring wells existed at the site, it was proposed that at least one well be drilled for detection purposes, and that a local water supply well be inventoried to provide background water-quality data. However, access was denied by the site owners.

Site IN I-2. The disposal area at this southwestern Indiana site has received waste-water sludge from a large metal fabricating plant since 1969. The principal hazardous components of the sludge are chromium, phosphorus, and fluoride. Fire clays and shales in the coal sequence underlying the site

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render the base of the mine pits quite impermeable, and sludge dumped into the pits stands until the water fraction evaporates. No monitoring wells were present at the site, nor were there seepage springs or private wells that could be sampled. At least two wells are required for monitoring. The owner had given permission for access, but the project was terminated before field work could begin.

Site IN I-3. The site is an open dump located in central Indiana. Records of types and quantities of waste received by the site are scarce, although a rubber plant and sewage treatment plant were reported to have been the major industrial waste contributors. The waste was deposited into an abandoned gravel pit on the flood plain of a river. No monitoring network was ever implemented. The site has been the subject of litigation since 1972, and was not accepting refuse in August 1976. The circumstances of the site's operation did not fit project criteria.

Site IN I-4. This landfill is located in central Indiana. Municipal waste and industrial waste including heavy metal hydroxide sludges and solvents have been accepted at the site for a little less than five years. Geological data show the area is underlain by about 3 m (10 ft) of sandy clay and 9 m (30 ft) of sand and gravel above blue clay. The site is situated at the edge of a river flood plain. Three monitoring wells are present, finished in the sand and gravel. The relatively young age of the landfill, and the small quantities of hazardous waste involved, eliminated this site from consideration.

Site IN I-5. This landfill is located in central Indiana. Scrap from the manufacture of insulation containing phenolic binder material was deposited from 1970 through 1973 on land owned by the company and located adjacent to the plant. The site is situated on a flood plain between the confluence of two rivers. Well logs indicate that the area is underlain by about 6 m (20 ft) of sand and gravel, 9 m (30 ft) of clay, and limestone bedrock. Since no monitoring wells were found at the site, at least two would be needed: one for background water quality and one for detection of contamination. Permission had been granted for drilling, but the site was not studied due to early termination of the project.

Site IN I-6. The site, in central Indiana, is a municipal landfill. Metal hydroxide sludges and oil-saturated soil have been accepted in addition to the municipal refuse. The industrial waste has been accepted only since 1974. Field observations indicated that the area lies on silty clay material with some stringers of sand. The landfill is situated on a hill that slopes toward an intermittent stream. No monitoring wells were available. It was determined that three would be necessary: one for background and two for detection purposes. Because of the relatively short time over which hazardous wastes have been disposed, the site was eliminated from consideration for further study.

Site IN I-7. This landfill is located in northwestern Indiana. Hazardous waste has been accepted at the site since 1967, and has included metal hydroxide sludges, oil sludges, and paint waste. A one-time disposal of 114 litres (30 gal.) of 5 percent DDT solution took place. Available data concerning the hydrogeologic setting was incomplete. Bedrock is thought to be at least 91 m (300 ft) deep. No monitoring wells are present, but installation of two should be sufficient to detect contamination and yield background data. Pemission had been obtained for drilling, but further field work was not undertaken due to early termination of the project.

Site IN I-8. This site, in eastern Indiana, is a landfill that has received metal hydroxide sludges, lubricating oils, and municipal waste since 1972. The area is underlain by about 27 m (90 ft) of silty clay till over fractured limestone bedrock, with a persistent water-yielding sand zone found at about 7.5 m (25 ft). Two observation wells were present, but one was dry and probably plugged. During inspection it was determined that at least two more monitoring wells would be required: one to determine background water quality and one for detection of contamination. The relatively young age of the facility coupled with the slow migration rate of water through clay till eliminated this site from further consideration.

Site IN I-9. This landfill, located in northeastern Indiana, was a burning dump prior to becoming a landfill in

1967. Municipal, demolition, and unknown types and quantities of industrial wastes have been accepted at the site. Geological records indicate that the site is underlain by 24 to 27 m (80-90 ft) of sandy clay, sand, and gravel over limestone bedrock. Eight monitoring wells were available, but another site adjacent to this one offered better records and easier access, so this site was eliminated from further study.

Massachusetts

Site MA I-1. This private waste lagoon site, located in north-central Massachusetts, is less than five years old. The total site area is less than 0.8 ha (2 acres) and includes a waste lagoon about 9 m (30 ft) in diameter. A large tank was observed, apparently being readied for burial as a holding vessel for some undetermined liquid waste. A black tar-like substance, probably a petroleum waste, was observed in the lagoon and on the ground at several locations.

Massachusetts state personnel related that the individual who owns and operates the site has conformed with existing regulations and has obtained the proper permits, although there is concern that leachate migration from the site may occur, especially to nearby watershed lands.

The site is situated at the foot of a steep hill near a wetlands area. A dug well on the site about 15 m (50 ft) from the lagoon showed ground water at about 46 cm (18 in.) below existing grade, and the geology to be sands and gravels. This well would probably render a good downgradient monitoring

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sample; a well uphill from the site might supply a background sample. However, access to the site was denied.

Site MA I-2. This south-central Massachusetts site was inspected in October 1976. About 3.2 ha (8 acres) of a 6-ha (15-acre) gravel pit are now filled with mostly municipal refuse. The thickness of the waste material averages 6 to 7.5 m (20 to 25 ft). A steaming patch of black, partially dried sludge of unknown origin and composition was noted on top of the fill. The age of the facility is not known.

The site is underlain by coarse sands and gravels over metamorphic bedrock. No monitoring wells exist at the site. Lack of background information eliminated this site from additional study.

Michigan

Site MI I-1. The site is located in east-central Michigan, and consists of a landfilling operation carried out in pits left from previous sand mining. Hazardous waste, including 9,460 litres (2,500 gal.) per month of chromium hydroxide sludge, calcium, silica, aluminum, chloride, fluoride, and magnesium has been buried at the site since 1974.

Soil boring and well data indicate that the area is underlain by glacial drift to a depth of at least 21 m (70 ft). The drift is composed of sand and gravel with discontinuous clay layers. The site is about 18 m (60 ft) higher than a river that forms the property boundary 0.4 km (0.25 mi) away. This surface water course is the natural ground-water discharge point for the surficial aquifers in this area. No monitoring facilities exist at the site. Optimum pollution detection considerations suggest that one monitoring well be drilled near the disposal pit, between that facility and the river. A water supply well could be inventoried to provide a background sample. This work was not carried out because of early project termination.

Site MI I-2. The site is located in north-central Michigan, and consists of lagoons and a natural pond on the property of a metal fabricating plant. Disposal began in the late 1950's; the two older lagoons near the plant were abandoned and covered in 1971. At that time, a series of new lagoons located about 91 m (300 ft) south of the plant became operational. The effluent pond lies about 457 m (1,500 ft) south of the plant. Prior to 1973, the discharge was untreated, and both the lagoons and the natural pond received effluent containing toxic materials, including cyanide and hexavalent chromium. Since that time, the total discharge has been segregated so that the pond receives the less hazardous portion of the waste stream. Discharge of the waste process water is estimated at 11 litres/sec (174 gpm).

Data from soil borings and well logs indicate that the area is underlain by about 152 m (500 ft) of glacial drift over shale bedrock. The upper section of drift consists of about 30 m (100 feet) of sand and gravel over 15 m (50 ft) of clay. At least two monitoring wells are necessary for a study of the

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site, one near the abandoned and filled lagoon sites, and the other near and downgradient from the new lagoons. Existing wells at the site could provide background water quality. Early project termination prevented further study of this site.

Site MI I-3. The site is located in southeastern Michigan, and consists of a high temperature incinerator, barrel storage area, lagoons for liquid waste storage, and a storm-water retention basin. Combustible liquid wastes are trucked in for disposal by incineration. Although the operation is reported to have begun in 1968, protective measures such as berms, subdrains, liners, monitoring wells, and other control features were not constructed until 1975. The site covers approximately 4 ha (10 acres). The site is situated within a garbage filled gravel pit. The pit area is underlain by glacial outwash and lake deposits that are reportedly at least 40 m (130 ft) thick. The outwash portion consists of 6 to 9 m (20-30 ft) of sand and gravel and overlies sandy lacustrine clay. Another zone of sand and gravel of unknown thickness is present below the clay. Ten monitoring wells are presently finished in the old refuse fill and underlying sand and gravel at depths of 9 m (30 ft) below land surface. Depths of the water table range from 4 to 6 m (13-20 ft).

The site was not sampled because the ground-water flow pattern in the region is complex and quality is complicated by the existence of the old fill material and the possible adulteration effects of other nearby disposal facilities.

Site MI I-4. The site is located in southeastern Michigan, and consists of sludge settling lagoons and sludge storage beds on the property of a metal fabricating plant. Treated waste water is composed of acidic plating waste containing chromium, copper and zinc, and alkaline waste containing copper and zinc cyanide complexes.

Soil boring data indicate that the area is underlain by 4.5 to 9 m (15-30 ft) of stiff sandy clay over broken limestone and shale. This is a near shore site with the water table within 1.5 m (5 ft) of land surface. Study of this particular site was proposed because of the geologic setting of tight clay which is in contrast to the more common conditions of sand and gravel in Michigan. However, access to the site was denied by the owners.

Site MI I-5. A chemical company plant located in central Michigan has contaminated land around the plant site with polybrominated biphenyls (PBB's) through spills, and careless handling and storage methods that allowed escape of the chemicals to the environment. Geologic data from well logs indicate that the area is underlain by alluvium and glacial drift to a depth of at least 60 m (200 ft). The alluvium consists of 3 to 6 m (10-20 ft) of sand and gravel, and overlies a section of hard clay and gravel about 15 m (50 ft) thick, below which sand and gravel strata alternate with clay layers. The site is located on a river flood plain.

No ground-water monitoring facilities exist at the site.

Installation of two monitoring wells for detection purposes were proposed, but request for permission to install these was refused by the company.

Mississippi

Site MS I-1. This site, located in the southwestern corner of the state, has sludge settling lagoons and a spray irrigation facility for chemically treated waste liquids. It has been operating since 1974. The Mississippi Geological Survey has installed six test holes 40 to 46 m (130-150 ft) deep. Drillers' and electrical logs indicate the area is mantled with fine- to medium-grained sand to depths ranging from 17 to 26 m (55-85 ft) above clay and clayey sand from 6 to 9 m (20-30 ft) thick, overlying permeable sand with some gravel to the depth of penetration. Monitoring wells later installed at these test hole sites were finished at a final depth of 24 m (80 ft). The wells are situated at distances thought to be too great for contamination to have reached them at present. Plans for sampling and drilling of additional monitoring wells at the site were cancelled due to early project termination.

Site MS I-2. This site is located in central Mississippi, and consists of five abandoned seepage lagoons that are now filled and covered with sandy material from the active portion of the sand pit which contains them. During the many years that these lagoons were operational they received large but unknown volumes of acidic liquid and sludge residues containing heavy metals from a nearby used-oil refinery. Subsurface drainage of the waste liquids is evidenced by the presence of many dead trees between the disposal grounds and a nearby downgradient swampy area. One monitoring well placed here, and another one situated upgradient for background control, should provide an adequate monitoring network for this facility. Early project termination cancelled drilling and monitoring plans at this site.

Site MS I-3. The site is located in north-central Mississippi, and consists of a seepage lagoon and adjacent sand trenches used for the disposal of chromium-rich liquid and sludge waste from a local industry. The site is situated on the flank of a steeply sloping ridge underlain with a thick section of fine to medium sand with some thin lenses of clayey sand. No records are available pertaining to the geology, but inspection indicated that ground water probably flows southwest toward a creek about 3 km (2 miles) away. Plans for the drilling of monitoring wells were cancelled because of early project termination.

Site MS I-4. The site is located in northeastern Mississippi, and consists of a 17.4-ha (43-acre) landfill. Large quantities of chemicals, sludges, and paint wastes mixed with non-hazardous refuse have been accepted. The site is situated in a lowland marshy area about 760 m (2,500 ft) from a major creek. Sandy formations are exposed nearby, but the geology of the underlying area is not known. Monitoring plans were cancelled because of early project termination.

Site MS I-5. The site, located in east-central Mississippi, is comprised of an open burning dump, now abandoned. Commercial oil, paint, and textile mill wastes are reported as a part of the total waste accepted; however, no identifiable residues were found. Because of the unknown type and quantity of hazardous wastes that might have been discarded here, the site was excluded from detailed study.

Site MS I-6. The site, located in west-central Mississippi, consists of an abandoned sanitary landfill that began as an open dump. No dependable information concerning the types of waste received was available, thereby eliminating the site from further consideration.

Site MS I-7. The site is located in extreme western Mississippi, and consists of a landfill exceeding 16 ha (40 acres) in size. The landfill is located on a flood plain and is underlain by alluvium. The lack of dependable background data made this site undesirable for additional investigation.

Site MS I-8. The site is located in central Mississippi, and is an abandoned open dump. Many types of domestic, commercial, and industrial wastes were discarded from about 1940 to 1975. Surface-water contamination from the landfill is a continuing problem. Ground-water contamination also is a potential problem. Because of site selection criteria considerations, the fact that all available lands for monitoring well location are covered with refuse makes the site unacceptable for project inclusion.

Site MS I-9. The site is located in central Mississippi, and consists of a three-year old landfill. No appreciable amounts of hazardous wastes have been documented, but its proximity to a public water supply well prompted public officials to request an investigation. Well-drained lowlands in a major valley are being filled with compacted refuse and then covered daily with about 0.6 m (2 ft) of sandy clay that is graded to conform to the sloping hillside topography. Surficial and underground drainage is in the opposite direction from the municipal supply well that is located about 400 m (1,300 ft) away. Because hazardous waste deposition appears negligible, the site was not studied further.

Site MS I-10. This site, in central Mississippi, was an open dump. Before abandonment, industrial oil and paint sludges were said to have been a portion of the waste materials. Because of the lack of records covering waste type and amount, no additional investigation is planned.

New Hampshire

Site NH I-1. This lagoon site in southeastern New Hampshire is owned by a private chemical company and adjoins a municipal landfill site that was drilled and sampled as part of the project. The lagoon, believed to be receiving synthetic organic liquid wastes, was inspected at the same time as the municipal landfill. No field work was undertaken here due to problems of obtaining access.

Site NH I-2. The site, located in southern New Hampshire, consists of land not formally designated as a dump or landfill, upon which tannery sludges and other wastes have been dumped. Local citizens customarily dump domestic refuse as well. Very little is known by the state officials regarding the site, including its ownership. No field work was undertaken because of the lack of records.

New Jersey

Site NJ I-1. This site is a 16-ha (40-acre) landfill located in southwestern New Jersey. The facility accepts some solid industrial wastes, but dumping of liquids and chemical waste is prohibited. The site is located in a wetland and a creek bounds the site on three sides Two observation wells had been installed and analyses of ground water showed contamination from copper, lead, and arsenic. The existing evidence of ground-water contamination removed this site from further consideration as part of the project.

Site NJ I-2. This site is a 26-ha (65-acre) landfill that receives municipal waste, animal wastes from nearby farms, and industrial wastes including some chemical waste. Current waste volume is about 1,350 tonnes/day (1,500 tons/day). A diked ditch acts as a leachate collector. Liquid collected in the ditch is pumped back to the surface of the landfill. There are eight monitoring wells finished at various depths. Ground-water quality data showed that a deep aquifer has been contaminated by cadmium and lead, and by several other non-hazardous constituents. These data eliminated the site from additional study.

Site NJ I-3. This landfill, located in southwestern New Jersey, occupies about 20 ha (50 acres) and is about 24 m (80 ft) thick. The facility receives little or no industrial waste. A major aquifer underlies the disposal site, and apparently leachate is percolating into it as no surface seeps have been observed. The lack of evidence for significant contributions of industrial waste precluded further investigation.

Site NJ I-4. This landfill, located in southwestern New Jersey, is characterized by a relatively flat surface with very steep side slopes and a thickness of about 15 m (50 ft). The filled area covers about 8 ha (20 acres). The landfill accepts primarily municipal, septic, and non-chemical waste. During inspection, a load of liquid chemical waste was refused entry by the State inspector accompanying the Geraghty & Miller, Inc. representative. Three monitoring wells had been installed and arsenic, cadmium, copper, and lead were detected in the ground water. This evidence of ground-water contamination eliminated the site from more detailed study.

Site NJ I-5. This site is located in southwestern New Jersey, and is a landfill of about 36 ha (90 acres). The landfill has been closed 25 years and is covered with dense plant growth. Monitoring wells were installed about 20 years ago, but no analytical data were available. The only monitoring well found was dry at the time of inspection. The length of time that the landfill has been inactive and the lack of data on wastes received led to its being omitted from drilling and sampling.

Site NJ I-6. This landfill covers only 2.0 ha (5 acres) and is located in southwestern New Jersey. It is presently used for the disposal of sludge produced by a chemical company's waste water treatment plant. The chemical composition of the sludge was not known, but samples taken from shallow monitoring wells contained nickel, lead, and copper. This site would have qualified for further study if the project were not terminated.

Site NJ I-7. This landfill is comprised of an inactive 20-ha (50-acre) acre and an active 4-ha (10-acre) area. It is located near the Delaware River in southwestern New Jersey. The site is underlain by a permeable aquifer recharge area. The amount of industrial waste accepted is not documented, but it could be substantial as several large industries are nearby. One monitoring well was installed and it appeared to be contaminated with arsenic, barium, zinc, and selenium. No background samples were available for comparison. Evidence of contamination is great enough to delete this site from further study.

Site NJ I-8. This landfill is located in southern New Jersey and consists of an abandoned landfill and an area being readied for expansion. Two monitoring wells are present, but the data from them are inconclusive regarding contamination by hazardous constituents. Because of the transition of the site from inactive to active and lack of historical records, the site was omitted from further study. A leachate collection system is under construction at this site.

New York

Site NY I-1. This northwestern New York site was inspected in October 1976. Filling activities at the 24-ha (60-acre) landfill began in 1970. In addition to domestic garbage, industrial wastes such as paper pulp, those from felt manufacturing, and brewery sludge are accepted. Liquid wastes are deposited into a dug pit, pumped through irrigation header pipes and sprayed upon vegetated land. The system is designed so that runoff from the spray irrigation area will drain back into the reception pits. The reception pits are unlined, and the site is situated upon unconsolidated silts, sands and gravels with a potential for leachate migration.

Four monitoring wells are installed at the site. The landfill appeared to qualify as a sampling site based upon project criteria, until municipal authorities in charge of the facility refused cooperation and access.

Site NY I-2. The site, located in northeastern New York State, covers about 57 ha (140 acres). Landfilling operations began in about 1970. Sand pit excavations are filled to a depth of 15 m (50 ft) or more after they are vacated. Records do not indicate hazardous waste disposal; however, during inspection of the site in October 1976 it was evident that paints, sludges, and other types of industrial waste had been dumped along with municipal refuse, presumably in violation of operational codes. Since operating records could not be obtained the site was excluded from further study.

Site NY I-3. Operations began in 1972 at this 40-ha (100-acre) landfill site located in northeastern New York State, west of the Hudson River. At the time of inspection in October 1976, about 6 ha (15 acres) of hillside land had been filled by excavating 3 to 3.6 m (10-12 ft) of cover material and refilling with refuse. Operational specifications for the site do not permit the acceptance of septic or sewage sludge, or any generally hazardous materials. However, field inspection indicated that a limited but significant volume of industrial liquid and solid waste have been recently deposited at the site. At least some of these wastes are from a sizable electronics manufacturing facility, thus raising the possibility of PCB contamination.

The landfill is on the side of a hill in sandy soils, and ground water occurs generally within a few feet of land surface. Bedrock is suspected to be at shallow depths throughout the area. An operating gravel pit lies downgradient of the landfill, and a narrow marsh is present at the foot of the hill. Ground water moving downhill emerges as springs where bedrock approaches ground level. An underdrain system supposedly intercepts leachate generated from the landfill for removal to treatment facilities. However, observed leachate springs near the fill toe suggest that the drain system is not entirely successful. Incomplete records excluded this facility from the project.

Pennsylvania

Site PA I-1. This municipal landfill site, located in southeastern Pennsylvania, covers 16 to 20 ha (40-50 acres). It has been operating as a managed landfill for at least ten years, and possibly longer as an open dump. The fill is contained in a narrow stream valley, near a major river, and attains a height of about 9 m (30 ft) above the valley floor. Unconsolidated deposits are very thin, and are underlain by shale bedrock.

A number of monitoring wells are reportedly installed: two at a downgradient location, one background well, and some wells within the filled area. All are finished in shale. During the inspection one downgradient monitoring well was located; the other could not be found. Furthermore, the background well was discovered to have been filled with debris by vandals. Wells inside the filled area were observed but not closely inspected since they did not comply with project criteria. Moreover, the site was reported to have received only municipal wastes. It was decided to exclude this site from sampling, because of the lack of records.

South Carolina

Site SC I-1. This site, which contains five unlined seepage lagoons, is located near the northwestern corner of the state. It was in operation from 1970 until October 1975. The lagoons, in tight clay soils underlain by dense metamorphic bedrock, received large but unspecified volumes of hazardous industrial liquid wastes containing oil, chromium, cadmium, copper, zinc and nickel from metals industries, plus dyes from nearby textile plants. During inspection, all lagoons were observed to be almost full of varicolored liquids, although no industrial waste fluids had been received since September 1975. This fact suggests that the low permeability of the clay deposits has effectively isolated the local ground-water reservoir from this particular source of contamination. An existing domestic well 305 m (1,000 ft) upgradient, and a spring located about 30 m (100 ft) downgradient of one lagoon, could serve to monitor any localized ground-water contamination resulting from seepage beneath the waste lagoons. Early project termination prevented further study of this site.

Site SC I-2. At this eastern South Carolina site, more than 118 tonnes (130 tons) of organic pesticides were buried following an October 1974 warehouse fire at an agricultural chemical company. The fire damaged products discarded included large amounts of 18 different pesticides. The disposal method consisted of burial in two trenches, 2.1 m (7 ft) deep by 4.6 m (15 ft) wide by 52 m (170 ft) long, which were excavated in sand. Three test holes drilled at that time adjacent to the site penetrated fine to medium sand from land surface to depths ranging from 2.4 to 4.3 m (8-14 ft). Static water levels of 2 to 3 m (7-10 ft) below grade were recorded in these borings. At that time a monitoring well was constructed 30 m (100 ft) or so west of the burial grounds, at a point about halfway between the site and a sawmill water supply well. According to the sawmill owner, the monitoring well was never sampled after installation.

During the inspection of this site in June 1976, the sawmill owner stated that shortly after the burial operation took place the water from the mill well acquired such a bad odor and taste that no one could drink it. During site inspection it was also observed that the flow of contaminated ground-water toward the southeast has occurred, as evidenced by the presence of a faint pesticide odor and by leachate discoloration at a seep along the sides of a flooded sand and gravel pit located about 30 m (100 ft) away. No additional study of this site was done before the project was terminated.

Site SC I-3. This site, located on a small sandy island off the southeast coast, began operation as a municipal and industrial waste landfill in 1971. Since that time the site has received large quantities of creosote, heavy metal sludges, oil floc, asbestos fiber wastes, and vegetable canning residues. The site is underlain by fine to medium sand to a depth of at least 5.9 m (19.5 ft) according to the log of a State-drilled test hole. A 5-cm (2-in.) diameter PVC monitoring well, now inoperative, was installed in the test hole. However, this well does not conform to project well location criteria because it is situated within the landfill and, when installed, reportedly penetrated 1.2 m (4 ft) of garbage with a strong hydrocarbon odor. However, chemical analyses of samples taken from State files gave an indication as to the various constituents to be expected in leachate contaminated ground water leaving the disposal grounds. Copper, nickel, zinc, and phenols were all found in high concentrations.

During the inspection tour it was noted that a downgradient spring, about 9 m (30 ft) beyond the site boundary, showed discoloration typical of leachate contamination. A small diameter monitoring well could be easily installed in the vicinity of that spring for contamination detection. A number of upgradient domestic wells could be sampled for background quality. Early project termination prevented further study of this site.

Site SC I-4. This landfill site is located in the east-central part of the state and operated from 1972 through 1975, receiving liquid and sludge hazardous wastes from local industry, including oil floc and metal plating sludges, asbestos fiber, and discarded mercury vapor lights. These wastes were routinely mixed with domestic refuse. Available geohydrologic data indicate that sand, silty sand and sandy clay underlie the site to a depth of 30 m (100 ft) or more, and that the water table should be between 1.5 to 3 m (5-10 ft) below grade. Observations made during the inspection suggest a northward ground-water flow toward a nearby swamp, about 30 to 152 m (100-500 ft) away from the filled area. An interstate highway lies between these two points. Several oily seeps along a ditch beside this roadway were sampled in March 1976 by the State with inconclusive results. Resampling of these points and/or drilling and sampling one or more shallow monitoring wells nearby was planned for ground-water contamination monitoring. This was not accomplished before the project was terminated.

Site SC I-5. The site, more than 30 years old, is owned by an electrical manufacturing company located in northwestern South Carolina. Since the plant opening, large amounts of PCB's were used and disposed of. Disposal history indicates dumping of industrial wastes in three local landfills, with the exception of PCB wastes which were treated with aluminum oxide (Al_2O_3) and settled in two sludge lagoons. The clarified water from the lagoons was discharged to a nearby stream; sludge accumulations were periodically removed from the lagoons and were buried in trenches on plant property. The geohydrologic environment, a thick clayey soil overlying dense schist bedrock, with no known aquifers present, excludes the possibility for significant ground-water contamination. Moreover, the steep topography of the area causes rapid overland runoff of precipitation and any contamination it might transport, thereby insuring that only minimal infiltration of such contaminated liquids could occur before reaching some nearby surface water drainage course. The steep topography also made monitoring well siting difficult. For these reasons, the site was omitted from further project study.

Site SC I-6. This northwestern South Carolina site is located on the property of a private agricultural university.

Since 1975 various wastes generated by the school, including a considerable volume of pesticides, have been buried in a pit at a highland area near the campus. Soil materials at the site consist of dense impermeable clays of unknown thickness. One monitoring well exists but is located in the middle of the filled area, precluding its use as a sampling point in keeping with project criteria. As of the July 1976 inspection tour, no water-quality data were available for this well. In view of the nature of the soil materials and their low vulnerability to rapid leachate migration, and also the short length of time since disposal began, this site was not further investigated.

Site SC I-7. This site, which includes several industrial waste lagoons, is owned by a tool manufacturing company in northwestern South Carolina. Sludge and liquid plating wastes have been deposited in the lagoons since about 1975. The lagoons are excavated in and underlain by unconsolidated deposits in which dense, impermeable clays predominate. No monitoring wells now exist, but several are proposed. Because the site is quite young, and the earth materials are so clayey, it is doubtful that any major leachate migration has taken place. For these reasons no further work at the site seemed warranted.

Wisconsin

Site WI I-1. The site is a landfill located in east-central Wisconsin. Unknown quantities of industrial wastes were deposited at the site from 1969 until 1976, when it was closed under orders by the State. Some of the known constituents of the wastes are organic solvents, phenols and heavy metals. The area is underlain by up to 5 m (17 ft) of glacial clay and sand over dolomite bedrock. The dolomite is the primary aquifer for private wells in the area. One shallow well is located near the boundary of the property, but no records of chemical analyses or water levels were available. The site was eliminated from further study due to lack of adequate hydrogeologic information and monitoring facilities.

Site WI I-2. This landfill, located in eastern Wisconsin, has received both municipal and industrial wastes. Approximately 30 barrels per day of waste-water sludge containing chromium, copper, and lead from an electroplating process were added to the fill from 1950 until 1975. The area is underlain by about 12 m (40 ft) of glacial silt, sand, and clay over fractured dolomite bedrock. Since no monitoring facilities exist at the site, and little is known about the ground-water gradient, the site was eliminated from consideration for further study.

Site WI I-3. The site is located in east-central Wisconsin, and is a small landfill that accepts predominantly municipal wastes. Unknown quantities of glue waste and organic solvents have been disposed of in one location on the property. The site is situated in an area formerly excavated for sand and gravel. No monitoring wells are present. The site was not included in the original inventory and no background data were available. For these reasons no additional investigation of the site was undertaken.

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EVALUATION OF MONITORING TECHNIQUES

As specified in the project contractual Statement of Work, the investigation was carried out "with two categories of sites in mind."

"Category I sites are those with existing monitoring wells. Work with these sites in the project deals with gathering and evaluating existing State groundwater monitoring data* obtained at industrial waste disposal sites, with supplemental analysis at existing test wells for those parameters which the States did not examine. (*Although the terms 'State groundwater monitoring data' and 'State-monitored sites' are used, any suitable data that may be available from other governmental entities or private sources (such as industry) should also be considered.)

"Category II sites will be selected from those industrial waste disposal sites where no suitable groundwater monitoring wells exist. The project will involve the development and conducting of a sampling program to identify any groundwater contamination caused by the disposal of hazardous wastes at these sites."

The contractor's observations and conclusions with regard to monitoring at Category I sites are contained in this section of the report and are based on information collected during the study. As part of the project data base, 727 sites were inventoried in 41 states. Of these, 249 had at least some monitoring wells in place. Sixty were evaluated during the site-inspection phase of the study, and 32 of the more representative ones were subsequently sampled.

The following discussion is directed principally toward the type of monitoring required to determine whether migration of hazardous substances has occurred, and should not be construed as recommended standard procedure for all situations. There are many monitoring alternatives available depending on such factors as data collection objectives, regulatory needs, and economics. For example, the monitoring program required to supply information for litigation is quite different from one designed to establish whether a liner is effective in sealing off a landfill from an underlying aquifer. Regulatory monitoring based on zero discharge to ground water would call for a monitoring system substantially different in design than one based on a regulatory philosophy which allows ground-water quality degradation that is contained within the boundaries of the disposal site. Monitoring alternatives and procedures are described in detail in a number of EPA documents. 13-18)

Monitoring Objectives

One of the major reasons for installing monitoring wells is to provide early detection of adverse changes in ground-water quality before large-scale contamination problems result. Ground-water monitoring networks also aid in determining the effectiveness of ground-water protection measures; in providing geohydrologic and chemical information useful in designing future disposal sites in comparable environments; and in developing information which will help protect disposal site operators against unjustifiable complaints or help regulatory agencies enforce anti-pollution laws.

Based on the results of this study, however, it was found that monitoring wells are usually installed simply because existing regulations require them, with no specific objective in mind. This has led to poorly designed, installed, and operated monitoring facilities. Most of the systems observed involved one or more of the following deficiencies: the number and positioning of wells; their design, installation, and development; the method of sampling employed; the chemical constituents analyzed; and the disposition of analytical results.

Number, Positioning, and Design of Monitoring Wells

The number and locations of sampling points at a land disposal area should be controlled by the geologic and hydrologic conditions, and the nature of the waste found at that particular site. Accurate information regarding these parameters is required before even the most rudimentary ground-water monitoring system can be properly installed. In the simplest cases, only three sampling points would be required. These would include one upgradient well to provide data on background water quality; and two wells at different distances downgradient of the waste material to detect horizontal migration of contaminated ground water.

If more than one aquifer underlies a site, or in cases where complex geologic or ground-water flow conditions prevail, a much more elaborate monitoring-well network is required. At sites where monitoring of more than one aquifer is desired, each such unit should be screened by separate wells. An alternate method commonly employed is to screen the entire saturated zone penetrated by a test hole. However, this type of installation yields a composite sample derived from all aquifers open to the well, and may reflect marked dilution of contamination contained in only one segment of the saturated profile sampled.

The number of existing wells at the sites investigated ranged from the extremes of a single, poorly sealed shallow well, screened just beneath a layer of garbage and industrial wastes, to an elaborately monitored facility equipped with 22 properly designed and constructed wells finished at various appropriate depths within the underlying earth materials. The number of installed wells at the monitored sites studied generally ranged from four to eight. Monitoring networks of four wells, one at each corner of a site, were commonly observed. Also common were systems with two or more wells placed parallel to a nearby stream, between the surface-water body and the disposal area, with another well placed upgradient of the potential source of contamination.

At one of the monitored sites studied, a closely-spaced triangular array of exploratory borings used to determine the ground-water gradient were finished and retained as monitoring wells, even though out of position with respect to contaminant sources. In this particular instance, the disposal site owner refused permission to install additional monitoring wells, as part of this project. At some sites inspected, monitoring wells were located too far away from the sources to provide meaningful data; at one of these the nearest downgradient well was over 600 m (2,000 ft) away from the disposal grounds. At

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other sites, one or more of the existing monitoring wells could not be used for sampling because they were situated within the waste-filled area. At such locations, downward leachate migration might be indicated, providing the monitoring well is adequately sealed through the waste. However, no quantitative data regarding lateral migration can be obtained from such wells.

Also, to be adequate, monitoring wells must be correctly positioned in relation to the direction of contaminated groundwater flow away from the disposal area. Under natural (unpumped conditions) the water-table shape and slope in any given area is generally a subdued replica of the land topography. In such areas, contamination detection wells should be situated down the topographic slope from a disposal site, and a background well positioned upslope far enough away to intercept ground-water flow from off the site. On the other hand, if the cone of influence of a nearby production well extends beneath the disposal site, contamination movement may be diverted toward that well, thereby preventing detection in monitoring wells installed using water-table slope considerations based on topography alone. This condition was found at several of the monitored sites sampled during the project. For example, at one site, a monitoring well that was properly positioned from a predicted natural water-table gradient, based on topography, did not show any contamination from a nearby seepage lagoon. Contamination was detected, however, in a production well of a nearby industry located topographically upgradient.

The vertical placement of the monitoring well screen within the aquifer is also critical. For example, wells screened near the top of the zone of saturation may not detect contamination migrating in natural gradient flow paths along the base of an aquifer. In contrast, lighter-than-water constituents, such as hydrocarbons, may move along the top of the zone of saturation, thereby evading detection by monitoring wells screened only in the bottom portion of an aquifer. Near pumping centers, the contamination path may be greatly altered, both horizontally and vertically, between the source and the intake segment of the production well. The well screen may be tapping only the upper, lower, or some intermediate portion of the aquifer or flow direction may be affected by lenses of sediments of low permeability contained in the aquifer. In such cases, even when dealing with a single aquifer system, multiple well points should be installed, each one tapping the aquifer at a different depth. Very little consideration seems to have been given to factors dealing with vertical placement of monitoring wells at sites that were reviewed during the project. Instead, cost appears to have been the primary factor controlling the placement and design of many existing monitoring wells.

Site inspections also revealed examples where standard specifications, rather than individual site characteristics, were used for determining the construction of monitoring wells. Critical factors ignored included depth to the water table and thickness of tills and clays. Monitoring wells were found to be screened above the water table and to be completed in formations that would not yield enough water for adequate sampling.

One of the more significant aspects of monitoring well design is the selection of casing material. Sometimes casing material may contribute constituents to a sample as they are dissolved from the inner casing wall. At one site, elevated conconcentrations of zinc in water samples from monitoring wells were traced to new galvanized steel casing used in well construction. Casing material, whether PVC, steel, fiberglass, etc., should be chosen on the basis of the least predicted interference with regard to the potential contaminants of major concern at the particular site.

Another important factor in monitoring well design is casing diameter. Inside casing diameters between 1-1/4 and 2 inches have been found to be optimum from a convenience of sampling standpoint, allowing access by either bailer, centrifugal, or positive action pump. Where the water table is below suction limits, however, a 4-inch diameter well is favored because it allows use of a submersible pump. At sites inspected during this project, 1-inch diameter monitoring wells were found. This small diameter makes the use of any type of sampling equipment very difficult. At other sites, deep wells had been constructed where water was below suction limits, yet the well diameter was too small to install a submersible pump. In these cases, long periods were required to dewater the well with a bailer before a sample could be obtained.

During the study, poorly designed wells were eliminated from sampling consideration as much as possible. For those that were sampled, deficiencies were noted on sample submission sheets or field notes. All water analyses were later reviewed taking into account the design characteristics of each well.

Monitoring Well Installation

Hollow-stem augering is the prefered method for drilling monitoring wells because it is a dry operation, which eliminates adulteration of permeable formations by drilling fluids and additives. Core sampling through the hollow stem by Shelby tube or split-spoon provides an accurate geologic record of the section penetrated. The exact depth of each cored interval is known and the earth materials within the core are recovered intact. During the study, it was observed that this particular method of monitoring well installation is now gaining widespread acceptance. Other less advantageous, though commonly employed types of well installation methods include mud rotary, solid-stem auger, jetting, and driving.

Techniques for surface sealing of monitoring wells observed at disposal sites varied from concrete pads around the protruding well casings to backfilling with loose earth. Backfilling the hole around the casing and sealing at the surface to prevent surface-water seepage down the outside of the casing is best accomplished by a bentonite or cement slurry, and less effectively by dense clay bore-hole cuttings.

Following installation, and prior to sampling, monitoring wells should be properly developed, using surging, pumping, or other appropriate methods, so that clear water is produced while sampling. This was the practice for wells installed during this project. However, the majority of existing wells sampled at disposal sites produced silt-laden water, even after a period of pumping or bailing, indicating that little or no development following installation had been accomplished. Although an effort was always made to pump or bail each well long enough to obtain a clear sample, this goal was not always achieved. To compensate for this, the samples finally obtained had to be gravity settled or filtered, depending on the degree of turbidity, to reduce the amount of suspended sediments before adding sample preservatives. Wells installed as part of the project were fully developed before sampling.

Sampling Procedures

Water samples can be removed from monitoring wells by using various types of pumps or a bailer. Vacuum pumps (pitcher, centrifugal, peristaltic, and diaphragm pumps) are limited to water depths of about 25 feet or less, but can be effective for shallow wells. Air-lift pumps are capable of greater lifts and can be economically installed on each well, although a source of air must be transported to the well to operate the pump. Air lift should not be used where volatile organic compounds are of concern. Jet, piston, submersible, or turbine types of pumps are capable of lifting water from greater depths than the others. They are, however, relatively expensive, are not as readily transportable, and require the well casing diameter to be in excess of 3 inches.

Bailers sized to fit specific casing diameters can be used for well sampling at any depth, but are slow due to the small volume captured by each bail and the time needed for repeated trips in and out of the well casing. If a single bailer is used to sample a number of different monitoring wells, the bailer must be properly cleaned after sampling each well to insure that no adulteration of subsequent water samples will occur. This precautionary cleansing measure also must be taken with any type of portable pumping equipment used for sampling.

Before a water sample is collected from a monitoring well for chemical analysis, all of the water formerly stored in the well casing must be withdrawn and discharged to waste. This pre-sampling evacuation is necessary because the standing water removed may have remained essentially stagnant in the casing since its last sampling period, from weeks to months before. In order to insure that all stored water has been withdrawn, it is preferable to remove about three times the actual volume of water stored in the casing.

At most of the existing monitoring facilities studied, bailer sampling was the primary method used by both regulatory and site-operator personnel. This is mainly due to the reduced expense and convenience of bailers. Observed sampling techniques and practices of site operators, their engineering consultants, and regulatory-agency personnel indicate that routinely sampled monitoring wells rarely are totally dewatered prior to sampling. This monitoring deficiency appeared to be attributable to lack of knowledge concerning the importance of prior dewatering. The time and work involved in attempting to dewater a well with a bailer was the primary reason cited for premature sample collection.

Because many monitoring wells are not developed to yield samples free of suspended matter, any water samples obtained from them usually must be filtered or settled prior to addition of preservatives in the field. If this is not done, ions adsorbed on silt, clay, and organic particles present in the water sample may be redissolved by the addition of preservatives. This can result in finding high concentrations of certain constituents during analysis which are not representative of the quality of the ground water. State officials and private consultants at some of the disposal sites inspected and studied commonly added preservatives to turbid samples in the field. By contrast, the sampling procedure used for the project involved filtering all samples preserved for heavy-metals analysis through a membrane filter of pore size 0.45 micrometre, prior to addition of preservative. Portions of the sample designated for non-metals analysis were gravity settled or gravity filtered until a clear filtrate was produced before appropriate preservatives were added.

Immediate analysis of water samples is the best way to obtain truly representative quality of the water. However, since the laboratory is usually some distance from the well location, preservation of samples in the field is important to insure that the quality of the water remains unchanged until it can be analyzed in the laboratory. During transit, changes in temperature and exposure to the atmosphere can affect pH, and volatilization of organics can occur. Also, oxidation and precipitation of metals, and other reactions can occur, altering quality prior to analysis. Storage at low temperature (4 C) is effective in preserving samples. Chemical preservatives should be chosen with respect to the type of analyses that are to be made. Preservation of samples by cooling and other accepted methods appears to be a widespread practice among those involved in monitoring.

The most recent school of thought on the frequency of sampling is that it should be related to ground-water flow velocity. Examples of sampling frequencies as compared to flow rates are: annual sampling for velocities less than 75 feet per year; semi-annual sampling for velocities between 75 and 150 feet per year; and quarterly sampling for velocities in excess of 150 feet per year. Velocity of ground-water flow, of course, is dependent upon local geohydrologic conditions.

Another consideration is the general mechanism by which contamination is introduced to the water table. Lagoons and liquid-filled pits present a constant source of contaminated liquid. Therefore, the plume of contaminated water would tend to be continuous, and a sample representative of contaminated water at the monitoring well location can be obtained at any time. On the other hand, solid waste disposal facilities in humid areas may contribute only periodic slugs of contamination to ground water in response to seasonal recharge from precipitation. Under these conditions, fluctuation of contaminant levels in ground water with time may require scheduling of sampling to correspond with expected occurrences of peak contaminant flows. This factor rarely is considered in sampling requirements of most state regulatory agencies contacted during the project. Instead, a quarterly frequency of sampling by disposal site operators is most commonly required, no matter what geohydrologic conditions exist at the site and independent of the type of waste disposal facility being operated.

Where the operator is responsible for collecting and analyzing water samples, periodic sampling and analysis by state agencies are commonly carried out to compare results, but these spot checks rarely are timed to coincide with probable peak-occurrence periods. This particular problem of optimum timing also had to be faced during the project, which was basically designed for a one-time sampling trip to each site studied. As the scope of the project entailed confirming only the presence or probable absence of contamination above background levels, measuring the highest concentration of contaminants within a given flow situation was not critical.

The constituents selected for analysis at hazardous waste disposal locations should be site specific, taking into account the chemical composition of wastes disposed of at the facility. However, regulatory agencies commonly require analysis for only a limited number of basic constituents (such as iron, chloride, sulfate, and total dissolved solids) to indicate ground-water contamination. The principal reasons given are the high cost to run analyses for such constituents as heavy metals, cyanide, phenol, and organic compounds and the lack of fully equipped and certified state and private laboratories. In one of the most industrialized states in the northeast, for example, only one private laboratory had been certified by the State health department to carry out organic chemical analyses. The State laboratory itself could only handle samples from public water supply wells and was not being used for analyzing water samples from wells used to monitor specific sources of contamination, such as lagoons and landfills.

Because of the complex analytical needs of this project, considerable effort was devoted to evaluate laboratories that were equipped and competent to test for a comprehensive series of organic and inorganic constituents. During the laboratory selection phase of the project, it was found that there were a relatively small number of commercial laboratories with complete organic and inorganic analytical capabilities. It was observed, however, during the course of the project, that a wide range of laboratory facilities were used by disposal site operators. These included in-house facilities at industrial plants, large commercial laboratories, county health department laboratories, and even field testing kits, which at best give only approximate results.

Disposition of Data

Data generated by ground-water monitoring networks at hazardous waste disposal sites should be gathered and recorded on a standard form, and filed so that it is readily retrievable. Variation with time in the concentration of key chemical constituents should be displayed graphically. Short-term fluctuations which may be indicative of a slug situation, can be determined, and long-term trends can be evaluated, again by graphing the monitoring data. The information also can be used to correct monitoring deficiences at a particular site and to aid in designing monitoring systems at other sites in similar geohydrologic environments. The prevailing practice of some regulatory agencies was found to consist of a brief examination of analyses as they are received for abnormally high concentrations of constituents, and then to file the analyses for future reference. Because of the shortage in personnel, there was little time provided for an interpretation of the significance of the results over the long term. Time was also rarely available to resolve problems with respect to existing well design, replacement of destroyed wells, sampling procedures, and laboratory quality control.

CONCLUSIONS

1. Ground-water contamination at industrial waste land disposal sites is a common occurrence.
2. Hazardous substances from industrial waste land disposal sites are capable of migrating into and with ground water.
3. Few hydrogeologic environments are suitable for land disposal of hazardous waste without some risk of ground-water contamination.
4. Continued development of programs for monitoring industrial waste land disposal sites is necessary to protect ground-water quality.
5. Most old industrial waste disposal sites, both active and abandoned, are located in geologic environments where ground water is particularly susceptible to contamination.
6. Many waste disposal sites are located where the underlying aquifer system can act as a pipeline for discharge of hazardous substances to a surface-water body.
7. At sites presently monitored, the use of wells as an aid in evaluating ground-water conditions is generally poor, due to inadequacies with respect to one or more of the following parameters:
    - number of wells
    - distance of wells from potential contamination source
    - positioning of wells in relation to ground-water flow
    - selection of screened intervals
    - use of proper well construction materials
    - sealing against surface-water contamination, or inter-aquifer water exchange
    - completion methods, such as development, maintenance, and protection against vandalism

8. At sites presently monitored, the sampling program is generally poor due to inadequacies with respect to one or more of the following parameters:

- obtaining a sample representative of aquifer water
- sample preparation
- frequency of sampling
- availability of background water-quality data
- selection of constituents to be analyzed
- availability of laboratories
- maintaining records in usable form

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Mississippi. State Board of Health, Geological Survey.

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New York. Department of Environmental Conservation, Division of Solid Waste Management.

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APPENDIX A

COMPUTER PRINTOUT KEY

Values listed as <1.000 are less than an unspecified detection limit.

Values listed as <(less than) some number other than 1.000 are less than a detection limit equal to the absolute value of that number.

Values listed as present, but <0.001 under ORGANICS RESULTS are detectable, but non-quantifiable.

Values listed with zero or zeros equal to the number of significant digits in the analysis being reported, are missing data points.

Values listed as positive whole or decimal numbers are quantities detected in samples.

Values of 50 within EMISSION SPECTROSCOPY RESULTS indicate that constituent listed as "major" in the original analysis.

TEMPERATURE, DEGREES CELSIUS

SPECIFIC CONDUCTANCE, MICROMHOS/CM

DISSOLVED OXYGEN, MG/L

G4 GROUP = Fluoride, total cyanide, phenols, mercury, arsenic, hexavalent chromium, and selenium.

G5 GROUP = Sulfate, calcium, magnesium, chloride, phosphate, potassium, and sodium.

ORGANICS GROUP = PCB's: PCB's and related electronegative (halogenated) compounds.

Pesticides: Pesticides (halogenated types)

Volatiles: Volatile organic compounds

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ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-1, CT

SAMPLE NO.	WELL 1	WELL 2	WELL 4 BKG
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND
DATE SAMPLED	10/28/76	11/5/76	11/5/76
TIME	13:00		
TEMPERATURE	15.0	14.0	14.0
PH	6.6	6.8	6.1
SPECIFIC CONDUCTANCE	5333	2552	31724
DISSOLVED OXYGEN			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 2	WELL 4 BKG
ALUMINUM	.500	.100	.003
BARIUM	.001	.050	.001
CALCIUM	50.000	50.000	50.000
IRON	.100	.500	.005
MAGNESIUM	10.000	3.000	10.000
MANGANESE	.030	.100	.010
POTASSIUM	2.000	5.000	3.500
SILICA	3.000	1.000	.050
SODIUM	15.000	8.000	25.000
STRONTIUM	.500	.500	.500
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.050	.010	.005
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.002	.001	.001
COBALT	<.001	<1.000	<1.000
COPPER	.002	.001	.005
LEAD	<.001	<.001	.001

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-1, CT

SAMPLE NO.	WELL 1	WELL 2	WELL 4 BKG	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	<1.000	<1.000	
NICKEL	.001	.002	<.001	
SILVER	.003	.003	.030	
TIN	<1.000	<1.000	<1.000	
TITANIUM	.002	.001	<.001	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	.001	<.001	<.001	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	
CHROMIUM	.02	<.01	.03	
COPPER	<.01	<.01	.01	
IRON, TOTAL	4.10	120.00	.58	
MANGANESE	1.20	1.40	.09	
NICKEL	<.03	.02	.00	
LEAD	.00	.00	.10	
ZINC	.00	.00	.00	
BARIUM	.10	.20	.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.00	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-1, CT

SAMPLE NO.	WELL 1	WELL 2	WELL 4 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	1.2000	.2200	.8400	
CYANIDE	<.0050	.0050	<.0050	
PHENOLS	.0100	.0200	.0400	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	.0400	<.1500	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	.0200	.0600	.0600	
SULFATE	15.000	<1.000	1660.000	
CALCIUM	350.000	140.000	450.000	
MAGNESIUM	150.000	42.000	890.000	
CHLORIDE	3.000	265.000	14280.000	
PHOSPHATE	.240	.260	1.500	
POTASSIUM	70.000	53.000	290.000	
SODIUM	350.000	190.000	7300.000	

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ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-1, CT

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

STRONG H2S ODOR

SAMPLE CLEAR,SLIGHT GREENISH COLOR

TIDAL WELL

TOTAL WELL DEPTH: 10 FT

DISTANCE FROM DISPOSAL AREA: 200 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-1, CT

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES: APPX 1.0

REMARKS

LEACHATE ODOR

SAMPLE CLEAR

TOTAL WELL DEPTH: 17 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-1, CT

SAMPLE WELL 4 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
LIGHT VOLATILES:<1

REMARKS

H2S ODOR

SAMPLE CLEAR

BACKGROUND WELL

TOTAL WELL DEPTH: 17 FT

DISTANCE FROM DISPOSAL AREA: 1500 FT

(14)

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	9/14/76	9/14/76	9/14/76	9/14/76
TIME	13:00	15:00	16:30	17:00
TEMPERATURE	16,0	21,6	22,6	19,2
PH	6,9	7,2	6,9	7,0
SPECIFIC CONDUCTANCE	470	650	540	1200
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	1,000	2,000	3,000	10,000
BARIUM	,010	,010	,010	,050
CALCIUM	50,000	50,000	20,000	20,000
IRON	10,000	10,000	10,000	10,000
MAGNESIUM	2,000	5,000	3,000	5,000
MANGANESE	1,000	2,000	1,000	2,000
POTASSIUM	,100	2,000	,200	1,000
SILICA	10,000	10,000	50,000	50,000
SODIUM	2,000	15,000	3,000	5,000
STRONTIUM	,020	,200	,100	,150
ANTIMONY	<1,000	<1,000	<1,000	<1,000
ARSENIC	<1,000	<1,000	<1,000	<1,000
BERYLLIUM	<1,000	<1,000	<1,000	<1,000
BISMUTH	<1,000	<1,000	<1,000	<1,000
BORON	,003	,003	<1,000	<1,000
CADMIUM	<1,000	<1,000	<1,000	<1,000
CHROMIUM	,003	,001	,003	,005
COBALT	<1,000	<1,000	<,001	,002
COPPER	,050	,080	,010	,010
LEAD	,002	,001	<1,000	<1,000

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4
MOLYBDENUM	<1.000	<1.000	<1.000	<1.000
NICKEL	<.001	.003	.001	.003
SILVER	.001	.001	.001	.001
TIN	.001	<.001	<1.000	<1.000
TITANIUM	.050	.030	1.000	3.000
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	.001	.003
ZINC	.003	.002	<1.000	<1.000
ZIRCONIUM	<1.000	<1.000	<.002	.003
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	.00	<.01
COPPER	<.01	.12	.00	<.01
IRON, TOTAL	34.00	.14	.00	14.00
MANGANESE	10.00	5.00	.00	15.00
NICKEL	.00	.02	.00	.11
LEAD	<.01	.00	.00	.00
ZINC	.00	.00	.00	.00
BARIUM	.10	.10	.00	.20
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	.00	.00	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.2000	.1400	.1100	.0700
CYANIDE	<.0050	<.0050	<.0050	.0200
PHENOLS	1.3000	1.1000	.2400	1.4000
MERCURY	.0006	.0006	.0000	<.0005
ARSENIC	<.0300	<.0300	.0000	<.0300
CHROMIUM+6	<.0100	<.0100	.0000	<.0100
SELENIUM	.2000	.3500	.0000	<.0100
SULFATE	<1.000	<1.000	17.000	2.500
CALCIUM	36.000	56.000	.000	72.000
MAGNESIUM	6.400	8.700	.000	20.000
CHLORIDE	19.000	36.000	21.000	38.000
PHOSPHATE	1.600	5.100	.010	.020
POTASSIUM	6.300	9.800	.000	49.000
SODIUM	23.000	90.000	.000	92.000

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:APPRX 80

REMARKS

TOTAL WELL DEPTH: 15 FT

DISTANCE FROM DISPOSAL AREA: 150 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <,01,LIGHT VOLATILES: APPX 100

REMARKS

SAMPLE TURBID

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES: APPX 10

REMARKS

SAMPLE VERY TURBID

TOTAL WELL DEPTH: 25 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE WELL 4

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:APPX 1000

REMARKS

SAMPLE VERY TURBID

TOTAL WELL DEPTH: 25 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE NO.	WELL 5	LAGOON		
DISPOSAL TYPE	LAGOON	LAGOON		
WATER TYPE	GROUND	SURFACE		
DATE SAMPLED	9/15/76	9/15/76		
TIME	14:00	11:00		
TEMPERATURE	16.4	20.0		
PH	6.5	7.4		
SPECIFIC CONDUCTANCE	850	340		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	2.000	.010
BARIUM	.050	.010
CALCIUM	50.000	50.000
IRON	15.000	10.000
MAGNESIUM	8.000	5.000
MANGANESE	5.000	.100
POTASSIUM	.100	.100
SILICA	10.000	2.000
SODIUM	5.000	3.000
STRONTIUM	.500	.005
ANTIMONY	<1.000	<1.000
ARSENIC	<1.000	<1.000
BERYLLIUM	<1.000	<1.000
BISMUTH	<1.000	<1.000
BORON	.020	.010
CADMIUM	<1.000	<1.000
CHROMIUM	.003	.003
COBALT	<1.000	<1.000
COPPER	.010	.010
LEAD	<.001	.001

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE NO.	WELL 5	LAGOON		

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000	<1.000		
NICKEL	.003	.005		
SILVER	.001	.001		
TIN	.003	<.001		
TITANIUM	.100	.002		
TUNGSTEN	<1.000	<1.000		
VANADIUM	<1.000	<1.000		
ZINC	.003	.001		
ZIRCONIUM	<1.000	<1.000		
GERMANIUM	<1.000	<1.000		
TELLURIUM	<1.000	<1.000		

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00		
CHROMIUM	<.01	<.01		
COPPER	.06	.04		
IRON, TOTAL	29.00	2.40		
MANGANESE	8.60	.31		
NICKEL	.01	5.00		
LEAD	.00	.00		
ZINC	.00	.00		
BARIUM	.10	.10		
BERYLLIUM	.00	.00		
COBALT	.00	.00		
MOLYBDENUM	.00	.00		
TIN	.00	.00		
VANADIUM	.00	.00		

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE NO.	WELL 5	LAGOON		
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1200	.2600		
CYANIDE	<.0050	<.0050		
PHENOLS	.6000	.2600		
MERCURY	.0005	<.0005		
ARSENIC	<.0300	<.0300		
CHROMIUM+6	<.0100	<.0100		
SELENIUM	.4100	.0600		
SULFATE	<1.000	<1.000		
CALCIUM	92.000	92.000		
MAGNESIUM	22.000	4.500		
CHLORIDE	40.000	40.000		
PHOSPHATE	1.500	1.500		
POTASSIUM	10.000	2.800		
SODIUM	24.000	32.000		

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE WELL 5

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES: APPX 100

REMARKS

SAMPLE TURBID

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-2, CT

SAMPLE LAGOON

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES: APPX 5

REMARKS

SAMPLE GREEN WITH ALGAE

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 0 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-3, CT

SAMPLE NO.	WELL 1	WELL 3 BKG		
DISPOSAL TYPE	LANDFILL	LANDFILL		
WATER TYPE	GROUND	GROUND		
DATE SAMPLED	10/27/76	10/27/76		
TIME	11:00	15:00		
TEMPERATURE	10,1	11,0		
PH	6,7	5,8		
SPECIFIC CONDUCTANCE	912	117		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	,500	1,000
BARIUM	,005	,010
CALCIUM	50,000	8,000
IRON	,150	8,000
MAGNESIUM	10,000	2,000
MANGANESE	,030	,020
POTASSIUM	<,100	,200
SILICA	5,000	50,000
SODIUM	1,000	,750
STRONTIUM	,100	,010
ANTIMONY	<1,000	<1,000
ARSENIC	<1,000	<1,000
BERYLLIUM	<1,000	<1,000
BISMUTH	<1,000	<1,000
BORON	,003	,030
CADMIUM	<1,000	<1,000
CHROMIUM	,002	,010
COBALT	<,001	<,001
COPPER	,003	,010
LEAD	.002	,002

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-3, CT

SAMPLE NO.	WELL 1	WELL 3 BKG		

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1,000	<1,000
NICKEL	,002	,100
SILVER	,001	,002
TIN	<1,000	<1,000
TITANIUM	,005	,050
TUNGSTEN	<1,000	<1,000
VANADIUM	<1,000	<1,000
ZINC	,002	,010
ZIRCONIUM	<1,000	<1.000
GERMANIUM	<1,000	<1,000
TELLURIUM	<1,000	<1,000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	,00	,00
CHROMIUM	,01	<,01
COPPER	<,01	<,01
IRON, TOTAL	,05	,11
MANGANESE	,24	,15
NICKEL	<,03	<,03
LEAD	,00	,00
ZINC	,00	,00
BARIUM	<,10	<,10
BERYLLIUM	,00	,00
COBALT	,00	,00
MOLYBDENUM	,00	,00
TIN	,00	,00
VANADIUM	,00	,00

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-3, CT

C4 AND C5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 3 BKG		
FLUORIDE	.1800	.3400		
CYANIDE	.0070	<.0050		
PHENOLS	.0200	.0060		
MERCURY	<.0005	<.0005		
ARSENIC	<.0300	<.0300		
CHROMIUM+6	<.0100	<.0100		
SELENIUM	.0100	.0100		
SULFATE	20.000	15.000		
CALCIUM	160.000	22.000		
MAGNESIUM	57.000	3.500		
CHLORIDE	4.000	6.000		
PHOSPHATE	.030	.030		
POTASSIUM	2.300	3.700		
SODIUM	9.300	2.100		

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-3, CT

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<,01,LIGHT VOLATILES:<1

REMARKS

SAMPLE FAIRLY CLEAR WITH SLIGHT GRAY COLOR, TURBID AT FIRST

TOTAL WELL DEPTH: 12 FT

DISTANCE FROM DISPOSAL AREA: 250 FT

ANALYSIS OF WATER SAMPLES FROM

CONNECTICUT S-3, CT

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

SAMPLE QUITE CLEAR

BACKGROUND WELL

TOTAL WELL DEPTH: 12 FT

DISTANCE FROM DISPOSAL AREA: 750 FT

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE NO.	WELL 1	WELL 2	WELL 3	SOIL 2
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	SOIL
DATE SAMPLED	9/21/76	9/21/76	9/21/76	9/21/76
TIME	12:00		16:30	
TEMPERATURE				
PH				
SPECIFIC CONDUCTANCE				
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.200	4.000	3.000	1.000
BARIUM	.005	<1.000	<1.000	<1.000
CALCIUM	25.000	50.000	50.000	1.000
IRON	.010	.300	.500	.050
MAGNESIUM	1.500	5.000	5.000	.050
MANGANESE	.020	.050	.050	.020
POTASSIUM	<.100	.000	.000	.000
SILICA	50.000	20.000	10.000	50.000
SODIUM	2.000	1.000	.250	<.100
STRONTIUM	.500	2.000	2.000	.020
ANTIMONY	<1.000	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.003	.003	.001	.003
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.003	.002	<.001	.003
COBALT	<.001	<1.000	<1.000	<1.000
COPPER	.010	.005	.001	.005
LEAD	.001	<.001	<.001	.002

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE NO.	WELL 1	WELL 2	WELL 3	SOIL 2
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	<1.000	<1.000	<1.000
NICKEL	.002	<1.000	<1.000	<1.000
SILVER	.003	.001	<.001	<.001
TIN	<1.000	<1.000	<1.000	<1.000
TITANIUM	.005	.005	<.001	1.000
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<.001	<.001	<.001
ZINC	.002	<1.000	<1.000	<1.000
ZIRCONIUM	<1.000	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	.00	4.30
COPPER	<.01	<.01	<.01	1.30
IRON, TOTAL	.04	6.10	28.00	430.00
MANGANESE	.19	.18	4.30	2.80
NICKEL	<.03	.00	.00	.00
LEAD	.00	.00	.00	.00
ZINC	.00	.00	.00	3.00
BARIUM	.10	.00	.00	.00
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	.00	.00	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 2	WELL 3	SOIL 2
FLUORIDE	.1900	.3100	.3600	.0000
CYANIDE	.0000	<.0050	<.0050	<5.0000
PHENOLS	.0000	.0150	.0030	1.1000
MERCURY	.0000	<.0005	<.0005	<.1000
ARSENIC	<.0300	<.0300	<.0300	.0000
CHROMIUM+6	<.0100	<.0100	<.0100	.0000
SELENIUM	.0200	<.0100	<.0100	.0000
SULFATE	9.100	280.000	2650.000	.000
CALCIUM	110.000	122.000	626.000	.000
MAGNESIUM	7.600	12.000	89.000	.000
CHLORIDE	10.000	9.200	16.000	.000
PHOSPHATE	.090	.060	.030	.000
POTASSIUM	2.900	4.200	16.000	.000
SODIUM	10.000	12.000	30.000	.000

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES

REMARKS

SITE ACCEPTED ACID SLUDGE & WASTE CLAY FROM OIL REFINING

TOTAL WELL DEPTH: 80 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001,NOT PEST.OR PCB

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED ACID SLUDGE & WASTE CLAY FROM OIL REFINING

TOTAL WELL DEPTH: 55 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001,NOT PEST. OR PCB

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:2 PEAKS AT .01,LT.VOL:APX 1.8 VOLATILE ORGANIC(SOLVENT)

REMARKS

SITE ACCEPTED ACID SLUDGE & WASTE CLAY FROM OIL REFINING

TOTAL WELL DEPTH: 30 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE SOIL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECNEG.COMPOUNDS PRESENT APX .005,NOT PESTICIDE OR PCB

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:APX 300 MG/L

REMARKS

SITE ACCEPTED ACID SLUDGE & WASTE CLAY FROM OIL REFINING

DEPTH 18.5-20 FEET

INTERFERENCE ON AS & SE ANALYSES, MOISTURE 17%

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 50 FT

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                    ANALYSIS OF WATER SAMPLES FROM

                        FLORIDA S-1     , FL


SAMPLE NO,     SOIL 1
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DISPOSAL
 TYPE          LAGOON
WATER TYPE     SOIL
DATE SAMPLED   9/21/76
TIME
TEMPERATURE
PH
SPECIFIC
 CONDUCTANCE
DISSOLVED
 OXYGEN

 EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT
                            PERCENT


ALUMINUM           1,000
BARIUM            <1,000
CALCIUM            1,000
IRON                ,050
MAGNESIUM           ,080

MANGANESE           ,050
POTASSIUM           ,000
SILICA            50,000
SODIUM             <,100
STRONTIUM           ,020

ANTIMONY          <1,000
ARSENIC           <1,000
BERYLLIUM         <1,000
BISMUTH           <1,000
BORON               ,004

CADMIUM           <1,000
CHROMIUM            ,003
COBALT            <1,000
COPPER              ,003
LEAD                ,002
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ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE NO. SOIL 1

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000
NICKEL	<1.000
SILVER	<.001
TIN	<1.000
TITANIUM	.500
TUNGSTEN	<1.000
VANADIUM	.001
ZINC	<1.000
ZIRCONIUM	<1.000
GERMANIUM	<1.000
TELLURIUM	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00
CHROMIUM	4.80
COPPER	1.10
IRON, TOTAL	100.00
MANGANESE	1.40
NICKEL	.00
LEAD	8.00
ZINC	.00
BARIUM	.00
BERYLLIUM	.00
COBALT	.00
MOLYBDENUM	.00
TIN	.00
VANADIUM	13.00

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE NO.	SOIL 1			

G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	,0000
CYANIDE	<5,0000
PHENOLS	<.5000
MERCURY	<,1000
ARSENIC	,0000
CHROMIUM+6	,0000
SELENIUM	.0000
SULFATE	,000
CALCIUM	.000
MAGNESIUM	,000
CHLORIDE	,000
PHOSPHATE	,000
POTASSIUM	,000
SODIUM	,000

ANALYSIS OF WATER SAMPLES FROM

FLORIDA S-1 , FL

SAMPLE SOIL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECNEG.COMPOUNDS PRESENT APX .005, NOT PESTICIDE OR PCB

PESTICIDES
<.001

VOLATILES
HVY.ORG:APX 5800, 2 OTHER PEAKS APX 0.3 TO 1.0 FOR EACH PEAK

REMARKS

SITE ACCEPTED ACID SLUDGE & WASTE CLAY FROM OIL REFINING

DEPTH 8.5-10 FEET

INTERFERENCE ON AS & SE ANALYSES, MOISTURE 16%

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 50 FT

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ANALYSIS OF WATER SAMPLES FROM
ILLINOIS S-1 , IL

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	12/14/76	12/14/76	12/14/76	
TIME	14:40	16:30	12:25	
TEMPERATURE				
PH	7.0	6.8	7.2	
SPECIFIC CONDUCTANCE	700	2700	750	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 2	WELL 3 BKG
ALUMINUM	.150	.003	.020
BARIUM	.050	.050	.002
CALCIUM	50.000	50.000	50.000
IRON	.020	.150	.010
MAGNESIUM	15.000	15.000	15.000
MANGANESE	.003	.100	.002
POTASSIUM	.250	.100	<.100
SILICA	2.000	2.000	2.000
SODIUM	3.000	5.000	.250
STRONTIUM	.750	1.000	.100
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.020	.020	.003
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.002	.003
COBALT	<1.000	<1.000	<1.000
COPPER	.003	.003	.003
LEAD	.002	.001	.003

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ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-1 , IL

SAMPLE NO.	WELL 1	WELL 2	WELL 3BKG	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	WELL 1	WELL 2	WELL 3BKG
MOLYBDENUM	<1.000	<1.000	<1.000
NICKEL	.001	.003	.003
SILVER	.001	.001	.003
TIN	<1.000	<1.000	<1.000
TITANIUM	.005	.001	.002
TUNGSTEN	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000
ZINC	.002	<.001	<.001
ZIRCONIUM	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

	WELL 1	WELL 2	WELL 3BKG
CADMIUM	.00	.00	.00
CHROMIUM	<.01	<.01	<.01
COPPER	<.01	<.01	<.01
IRON, TOTAL	.01	11.00	<.01
MANGANESE	.00	1.40	.00
NICKEL	<.03	.08	<.03
LEAD	<.10	.00	.10
ZINC	.00	.00	.00
BARIUM	.10	.20	<.10
BERYLLIUM	.00	.00	.00
COBALT	.00	.00	.00
MOLYBDENUM	.00	.00	.00
TIN	.00	.00	.00
VANADIUM	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-1 , IL

SAMPLE NO,	WELL 1	WELL 2	WELL 3 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1400	.2500	.2600	
CYANIDE	<,0050	<,0050	<,0050	
PHENOLS	,0600	.1200	,0200	
MERCURY	<,0005	<,0005	<,0005	
ARSENIC	<,0300	<,0300	<,0300	
CHROMIUM+6	<,0100	<,0100	<,0100	
SELENIUM	<,0100	<,0100	<,0100	
SULFATE	,000	20,000	45,000	
CALCIUM	,000	510,000	150,000	
MAGNESIUM	,000	200,000	66,000	
CHLORIDE	,000	5,000	12,000	
PHOSPHATE	,000	,020	,050	
POTASSIUM	,000	15,000	1,500	
SODIUM	,000	110,000	4,000	

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-1 , IL

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED OIL,SOLVENTS,POSSIBLY PCB'S

SAMPLE SLIGHTLY TURBID

MONITOR WELL 1

TOTAL WELL DEPTH: 39 FT

DISTANCE FROM DISPOSAL AREA: 400 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-1 , IL

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED OIL,SOLVENTS,& POSSIBLY PCB'S

SAMPLE VERY TURBID

MONITOR WELL 2

TOTAL WELL DEPTH: 22 FT

DISTANCE FROM DISPOSAL AREA: 10 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-1 , IL

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED OIL,SOLVENTS, & POSSIBLY PCB'S

SAMPLE SLIGHTLY TURBID

MONITOR WELL 3 ,BACKGROUND

TOTAL WELL DEPTH: 37 FT

DISTANCE FROM DISPOSAL AREA: 500 FT.

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-2 , IL

SAMPLE NO.	WEST WELL	NORTH WELL	EAST WELL
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND
DATE SAMPLED	12/3/76	12/3/76	12/3/76
TIME	11:35	12:05	10:30
TEMPERATURE	10.2	86.0	96.0
PH	7.0	7.1	7.3
SPECIFIC CONDUCTANCE	1900	1300	850
DISSOLVED OXYGEN			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WEST WELL	NORTH WELL	EAST WELL
ALUMINUM	.002	.050	.250
BARIUM	.001	.050	.005
CALCIUM	50.000	50.000	50.000
IRON	.003	.200	.200
MAGNESIUM	20.000	20.000	20.000
MANGANESE	.030	.100	.100
POTASSIUM	.100	2.000	2.000
SILICA	.500	.250	2.000
SODIUM	5.000	10.000	10.000
STRONTIUM	.500	.250	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.002	.003	.005
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.003	.003
COBALT	.003	.003	.003
COPPER	.002	.005	.005
LEAD	<.001	<.001	.003

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-2 , IL

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	WEST WELL	NORTH WELL	EAST WELL	
MOLYBDENUM	<1.000	<.001	.001	
NICKEL	.005	.005	.005	
SILVER	.001	.001	.001	
TIN	<.001	<.001	.003	
TITANIUM	<.001	.002	.003	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	<.001	<.001	.003	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	WEST WELL	NORTH WELL	EAST WELL	
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	<.01	
COPPER	<.01	<.01	<.01	
IRON, TOTAL	.00	.04	.07	
MANGANESE	.56	.01	.01	
NICKEL	<.03	<.03	<.03	
LEAD	.00	.00	.00	
ZINC	.00	.00	.00	
BARIUM	<.10	.10	<.10	
BERYLLIUM	.00	.00	.00	
COBALT	<.01	.00	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-2 , IL

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WEST WELL	NORTH WELL	EAST WELL	
FLUORIDE	.3200	.0000	.0000	
CYANIDE	<.0050	.0000	.0000	
PHENOLS	.0500	.0000	.0000	
MERCURY	<.0005	.0000	.0000	
ARSENIC	<.0300	.0000	.0000	
CHROMIUM+6	<.0100	.0000	.0000	
SELENIUM	<.0100	.0000	.0000	
SULFATE	950.000	.000	.000	
CALCIUM	320.000	.000	.000	
MAGNESIUM	310.000	.000	.000	
CHLORIDE	20.000	.000	.000	
PHOSPHATE	.040	.000	.000	
POTASSIUM	5.300	.000	.000	
SODIUM	39.000	.000	.000	

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-2 , IL

SAMPLE WEST WELL

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED OIL,SOLVENTS,INKS,PAINT SLUDGE,& METALLIC LIQUID WASTE

MONITOR WELL WEST

TOTAL WELL DEPTH: 30 FT

DISTANCE FROM DISPOSAL AREA: 15 FT

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ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-2 , IL

SAMPLE NORTH WELL

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED OIL,SOLVENTS,INKS,PAINT SLUDGE,& METALLIC LIQUID WASTE

MONITOR WELL NORTH

TOTAL WELL DEPTH: 21 FT

DISTANCE FROM DISPOSAL AREA: 1500 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-2 , IL

SAMPLE EAST WELL

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED OIL,SOLVENTS,INKS,PAINT SLUDGES,& METALLIC LIQUID WASTE

MONITOR WELL EAST , BACKGROUND

TOTAL WELL DEPTH: 32 FT

DISTANCE FROM DISPOSAL AREA: 1200 FT

221

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-3 , IL

SAMPLE NO.	WELL 7 BKG	WELL 2		
DISPOSAL TYPE	LANDFILL	LANDFILL		
WATER TYPE	GROUND	GROUND		
DATE SAMPLED	12/7/76	12/7/76		
TIME	14:45	11:45		
TEMPERATURE	86,0	10,3		
PH	7,0	7,0		
SPECIFIC CONDUCTANCE	900	1700		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	1,000	,100
BARIUM	,100	,100
CALCIUM	50,000	50,000
IRON	,100	,200
MAGNESIUM	15,000	20,000
MANGANESE	,500	,100
POTASSIUM	,100	<,100
SILICA	10,000	,350
SODIUM	1,000	3,000
STRONTIUM	,100	,250
ANTIMONY	<1,000	<1,000
ARSENIC	<1,000	<1,000
BERYLLIUM	<1,000	<1,000
BISMUTH	<1,000	<1,000
BORON	,003	,001
CADMIUM	<1,000	<1,000
CHROMIUM	,003	,002
COBALT	,002	<,001
COPPER	,002	,002
LEAD	,001	<,001

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-3 , IL

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO,	WELL 7 BKG	WELL 2		
MOLYBDENUM	<1,000	<,001		
NICKEL	,002	,002		
SILVER	,001	,001		
TIN	,001	<,001		
TITANIUM	,003	,003		
TUNGSTEN	<1,000	<1,000		
VANADIUM	<1,000	<1,000		
ZINC	<,001	<,001		
ZIRCONIUM	<1,000	<1,000		
GERMANIUM	<1,000	<1,000		
TELLURIUM	<1,000	<1,000		

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO,	WELL 7 BKG	WELL 2		
CADMIUM	,00	,00		
CHROMIUM	<,01	<,01		
COPPER	<,01	,01		
IRON, TOTAL	<,01	,01		
MANGANESE	5,40	,60		
NICKEL	,00	<,03		
LEAD	,00	,00		
ZINC	,00	,00		
BARIUM	,10	,20		
BERYLLIUM	,00	,00		
COBALT	<,01	,00		
MOLYBDENUM	,00	,00		
TIN	,00	,00		
VANADIUM	,00	,00		

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-3 , IL

SAMPLE NO.	WELL 7BKG	WELL 2		

G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	.3500	.4800
CYANIDE	<.0050	<.0050
PHENOLS	.0200	.0900
MERCURY	<.0005	<.0005
ARSENIC	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100
SELENIUM	<.0100	<.0100
SULFATE	45.000	105.000
CALCIUM	120.000	270.000
MAGNESIUM	60.000	160.000
CHLORIDE	7.100	207.000
PHOSPHATE	.060	.120
POTASSIUM	2.000	.800
SODIUM	7.700	23.000

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-3 , IL

SAMPLE WELL 7 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
HEAVY ORGANICS: <,01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL OILS & SLUDGES WITH HEAVY METALS

MONITOR WELL 7, BACKGROUND

TOTAL WELL DEPTH: 16 FT

DISTANCE FROM DISPOSAL AREA: 1200 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-3 , IL

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL OILS & SLUDGES WITH HEAVY METALS

MONITOR WELL 2

TOTAL WELL DEPTH: 15 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-4 , IL

SAMPLE NO.	TAP BKG	WELL P-4	WELL P-6	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	12/6/76	12/6/76	12/6/76	
TIME	13:30	11:30	12:55	
TEMPERATURE	86,0	86,0	86.0	
PH	7,1	7,2	7.2	
SPECIFIC CONDUCTANCE	700	550	600	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	,003	,100	.050
BARIUM	,001	,005	.150
CALCIUM	50,000	50,000	50,000
IRON	,003	,002	.030
MAGNESIUM	10,000	20,000	20,000
MANGANESE	,002	,003	,003
POTASSIUM	<,100	<,100	<,100
SILICA	2,000	5,000	5,000
SODIUM	,250	1,000	1,000
STRONTIUM	,100	,100	.100
ANTIMONY	<1,000	<1,000	<1,000
ARSENIC	<1,000	<1,000	<1,000
BERYLLIUM	<1,000	<1,000	<1,000
BISMUTH	<1,000	<1,000	<1,000
BORON	,003	,010	,010
CADMIUM	<1,000	<1,000	<1,000
CHROMIUM	,001	,002	,003
COBALT	<,001	<,001	<,001
COPPER	,001	,005	,005
LEAD	<,001	<,001	,003

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-4 , IL

SAMPLE NO.	TAP BKG	WELL P-4	WELL P-6	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000	<1.000	<1.000
NICKEL	.001	.002	<.001
SILVER	.001	.001	.002
TIN	.003	<.001	.002
TITANIUM	<.001	.003	.002
TUNGSTEN	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000
ZINC	.010	<.001	<.001
ZIRCONIUM	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00
CHROMIUM	<.01	<.01	.00
COPPER	<.01	<.01	<.01
IRON, TOTAL	.01	.00	<.01
MANGANESE	.00	<.01	.00
NICKEL	.00	<.03	.00
LEAD	.00	.00	<.10
ZINC	1.30	.00	.00
BARIUM	<.10	<.10	.10
BERYLLIUM	.00	.00	.00
COBALT	.00	.00	.00
MOLYBDENUM	.00	.00	.00
TIN	<1.00	.00	<1.00
VANADIUM	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-4 , IL

SAMPLE NO.	TAP BKG	WELL P-4	WELL P-6	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1300	.1800	.2000	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.1100	.0400	.0600	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	30.000	40.000	35.000	
CALCIUM	95.000	67.000	80.000	
MAGNESIUM	51.000	42.000	48.000	
CHLORIDE	8.200	6.100	20.000	
PHOSPHATE	.030	.020	.040	
POTASSIUM	1.400	1.500	.690	
SODIUM	5.000	3.400	4.100	

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-4 , IL

SAMPLE TAP BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT SLUDGE,SOLVENTS, LIQUID METAL PLATING WASTE

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 500 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-4 , IL

SAMPLE WELL P-4

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
HEAVY ORGANICS: <,01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT SLUDGE,SOLVENTS, LIQUID METAL PLATING WASTE

MONITOR WELL P-4

TOTAL WELL DEPTH: 47 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

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ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-4 , IL

SAMPLE WELL P-6

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT SLUDGE,SOLVENTS, LIQUID METAL PLATING WASTE

MONITOR WELL P-6

TOTAL WELL DEPTH: 35 FT

DISTANCE FROM DISPOSAL AREA: 700 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-5 , IL

SAMPLE NO.	WELL 3	WELL 4	WELL 5 BKG	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	12/2/76	12/2/76	12/2/76	
TIME	13:40	14:15	12:55	
TEMPERATURE	96.0	96.0	86.0	
PH	7.1	7.1	7.3	
SPECIFIC CONDUCTANCE	500	470	800	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	1.000	.100	.005
BARIUM	.001	.001	.005
CALCIUM	50.000	50.000	50.000
IRON	.100	.100	.050
MAGNESIUM	10.000	3.000	5.000
MANGANESE	.030	.030	.030
POTASSIUM	3.000	1.000	.750
SILICA	2.000	.250	.100
SODIUM	20.000	30.000	25.000
STRONTIUM	.100	1.000	1.000
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.010	.050	.050
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.005	.001
COBALT	.001	<.001	.001
COPPER	.005	.003	.003
LEAD	.002	.002	.002

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-5 , IL

SAMPLE NO.	WELL 3	WELL 4	WELL 5 BKG	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	.010	.005	
NICKEL	.003	.003	.001	
SILVER	.002	.001	.001	
TIN	<.001	.003	.001	
TITANIUM	.005	.001	<.001	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	.001	.005	<.001	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	.01	.00	
COPPER	<.01	.01	.01	
IRON, TOTAL	<.01	.74	.08	
MANGANESE	.01	7.10	21.00	
NICKEL	<.03	.10	.00	
LEAD	<.10	.00	.10	
ZINC	.00	.00	.00	
BARIUM	.00	.00	.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.00	.00	
MOLYBDENUM	.00	<.03	<.03	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-5 , IL

SAMPLE NO.	WELL 3	WELL 4	WELL 5 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.3700	.7500	1.1000	
CYANIDE	.0070	.0000	.0000	
PHENOLS	.1000	.0000	.0000	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	45.000	.000	.000	
CALCIUM	54.000	.000	.000	
MAGNESIUM	15.000	.000	.000	
CHLORIDE	38.000	.000	.000	
PHOSPHATE	.050	.000	.000	
POTASSIUM	4.800	.000	.000	
SODIUM	41.000	.000	.000	

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-5 , IL

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL ORGANIC & HEAVY METAL SLUDGES

MONITOR WELL 3

TOTAL WELL DEPTH: 52 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-5 , IL

SAMPLE WELL 4

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL ORGANIC & HEAVY METAL SLUDGES

MONITOR WELL 4

TOTAL WELL DEPTH: 52 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-5 , IL

SAMPLE WELL 5 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL ORGANIC & HEAVY METAL SLUDGES

MONITOR WELL 5, BACKGROUND

TOTAL WELL DEPTH: 52 FT

DISTANCE FROM DISPOSAL AREA: 2000 FT

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-6 , IL

SAMPLE NO.	WELL 2A			
DISPOSAL TYPE	LANDFILL			
WATER TYPE	GROUND			
DATE SAMPLED	3/4/77			
TIME	11:00			
TEMPERATURE	14.4			
PH				
SPECIFIC CONDUCTANCE	7250			
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.005
BARIUM	.003
CALCIUM	50.000
IRON	.100
MAGNESIUM	2.000
MANGANESE	.030
POTASSIUM	.100
SILICA	2.000
SODIUM	10.000
STRONTIUM	.250
ANTIMONY	<1.000
ARSENIC	<1.000
BERYLLIUM	<1.000
BISMUTH	<1.000
BORON	.100
CADMIUM	<1.000
CHROMIUM	.001
COBALT	<1.000
COPPER	.002
LEAD	.002

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-6 , IL

SAMPLE NO. WELL 2A

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EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000
NICKEL	.002
SILVER	<1.000
TIN	.001
TITANIUM	<1.000
TUNGSTEN	<1.000
VANADIUM	<1.000
ZINC	<1.000
ZIRCONIUM	<1.000
GERMANIUM	<1.000
TELLURIUM	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00
CHROMIUM	.00
COPPER	.01
IRON, TOTAL	42.00
MANGANESE	3.80
NICKEL	.10
LEAD	.10
ZINC	.00
BARIUM	3.80
BERYLLIUM	.00
COBALT	.00
MOLYBDENUM	.00
TIN	.00
VANADIUM	.00

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ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-6 , IL

SAMPLE NO.	WELL 2A
G4 AND G5 GROUP RESULTS, MG/L	
FLUORIDE	.3900
CYANIDE	<.0050
PHENOLS	.0300
MERCURY	<.0005
ARSENIC	<.0300
CHROMIUM+6	<.0100
SELENIUM	.0200
SULFATE	29.000
CALCIUM	890.000
MAGNESIUM	180.000
CHLORIDE	4156.000
PHOSPHATE	1.300
POTASSIUM	88.000
SODIUM	830.000

ANALYSIS OF WATER SAMPLES FROM

ILLINOIS S-6 , IL

SAMPLE WELL 2A

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<.1

REMARKS

SITE ACCEPTED SOLVENTS (PHENOLS) & WASTES FROM PLASTICS MANUFACTURE

MONITOR WELL 2A

TOTAL WELL DEPTH: 13 FT

DISTANCE FROM DISPOSAL AREA: 90 FT

24

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , IN

SAMPLE NO.	SURF.DSCHG	WELL 1	WELL 2 BKG	WELL 3
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	SURFACE	GROUND	GROUND	GROUND
DATE SAMPLED	11/12/76	11/12/76	11/12/76	11/12/76
TIME	15:30	12:15	11:45	14:55
TEMPERATURE	14.0	12.5	86.0	14.0
PH	7.0	7.1	7.0	6.9
SPECIFIC CONDUCTANCE	1050	660	660	1000
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	SURF.DSCHG	WELL 1	WELL 2 BKG	WELL 3
ALUMINUM	.350	.003	.002	.005
BARIUM	.001	.005	.010	.010
CALCIUM	50.000	50.000	50.000	50.000
IRON	.100	.030	.030	.100
MAGNESIUM	5.000	8.000	10.000	8.000
MANGANESE	.030	.002	.003	.003
POTASSIUM	.250	<.100	<.100	<.100
SILICA	2.000	1.000	1.000	1.000
SODIUM	10.000	.150	.200	2.000
STRONTIUM	.500	8.000	8.000	3.000
ANTIMONY	<1.000	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.005	.003	.005	.020
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.005	.001	.001	.003
COBALT	.003	<.001	<.001	.002
COPPER	.010	.002	.003	.002
LEAD	.002	.001	.001	.002

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , TN

SAMPLE NO.	SURF.DSCHG	WELL 1	WELL 2 BKG	WELL 3

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	SURF.DSCHG	WELL 1	WELL 2 BKG	WELL 3
MOLYBDENUM	<1.000	<1.000	<1.000	<1.000
NICKEL	.003	<.001	<.001	.002
SILVER	.001	.001	.001	.001
TIN	<1.000	<.001	<.001	<1.000
TITANIUM	.003	<.001	<.001	.001
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000	<1.000
ZINC	<.001	.010	<.001	.010
ZIRCONIUM	<1.000	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	SURF.DSCHG	WELL 1	WELL 2 BKG	WELL 3
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	<.01	<.01
COPPER	.01	<.01	<.01	<.01
IRON, TOTAL	.85	<.01	<.01	1.20
MANGANESE	.32	.00	<.01	.04
NICKEL	<.03	.00	.00	<.03
LEAD	.00	<.10	<.10	.00
ZINC	.00	.92	.00	.00
BARIUM	.00	<.10	<.10	.00
BERYLLIUM	.00	.00	.00	.00
COBALT	<.01	.00	.00	.01
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , IN

SAMPLE NO.	SURF.DSCHG	WELL 1	WELL 2 BKG	WELL 3
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	1.2000	1.7000	1.7000	.7800
CYANIDE	<.0050	.0080	.0040	.0100
PHENOLS	12.0000	.1200	.0500	.1100
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	.0200	<.0100	<.0100	<.0100
SULFATE	110.000	50.000	30.000	110.000
CALCIUM	100.000	80.000	75.000	160.000
MAGNESIUM	22.000	50.000	56.000	56.000
CHLORIDE	285.000	21.000	12.000	42.000
PHOSPHATE	.560	.070	.070	.070
POTASSIUM	7.700	.780	.510	2.000
SODIUM	120.000	9.800	5.100	17.000

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , IN

SAMPLE SURF.DSCHG

ORGANICS GROUP RESULTS, MG/L

PCBS
.26 AS PCB'S

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES:<1

REMARKS

OILY ODOR, BLACK MATERIAL SETTLED OUT AFTER 24 HRS.

ESSENTIALLY UNDILUTED DISCHARGE FROM PLANT WATER TREATMENT

EXTREMELY BLACK COLOR, GREASY &/OR OILY

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , IN

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

HIGH ZN CONTENT MAY BE FROM STORAGE TANK

SAMPLE CLEAR

TOTAL WELL DEPTH: APPROXIMATELY 145 FT

DISTANCE FROM DISPOSAL AREA: 1250 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , IN

SAMPLE WELL 2 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 1150 FT

BACKGROUND WELL

24

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-1 , IN

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

CONTAM.(POTENTIAL PCB) CONFIRMED 6/76,PEC RESULTS CONFIRM JUNE RESULTS

SAMPLE CLEAR

TOTAL WELL DEPTH: APPROXIMATELY 145 FT

DISTANCE FROM DISPOSAL AREA: 650 FT

248

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-2 , IN

SAMPLE NO.	SUMP DSCHG	GW SEEP 1	GW SEEP 2	
DISPOSAL TYPE	COMB	COMB	COMB	
WATER TYPE	SURFACE	GROUND	GROUND	
DATE SAMPLED	11/8/76	11/8/76	11/8/76	
TIME	13:00	10:45	12:00	
TEMPERATURE	86.0	56.0	11.0	
PH	9.1	11.2	6.8	
SPECIFIC CONDUCTANCE	11500	10000	1300	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.020	1.000	.100
BARIUM	.001	.001	.200
CALCIUM	15.000	5.000	50.000
IRON	.050	.080	.150
MAGNESIUM	.250	.010	5.000
MANGANESE	.003	.002	.020
POTASSIUM	20.000	.100	.250
SILICA	.050	.100	2.000
SODIUM	50.000	50.000	3.000
STRONTIUM	.100	.002	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.002	.001	.010
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.001	.001	.002
COBALT	<.001	<.001	<.001
COPPER	.005	.001	.002
LEAD	.001	.001	.001

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-2 , IN

SAMPLE NO,	SUMP DSCHG	GW SEEP 1	GW SEEP 2	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT,)

SAMPLE NO,	SUMP DSCHG	GW SEEP 1	GW SEEP 2	
MOLYBDENUM	<1,000	<1,000	<1,000	
NICKEL	,020	<,001	<,001	
SILVER	,001	<,001	,001	
TIN	<,001	,005	<1,000	
TITANIUM	<,001	<,001	,002	
TUNGSTEN	<1,000	<1,000	<1,000	
VANADIUM	<1,000	<1,000	<1,000	
ZINC	<,001	<,001	<,001	
ZIRCONIUM	<1,000	<1,000	<1,000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1,000	<1,000	<1,000	

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO,	SUMP DSCHG	GW SEEP 1	GW SEEP 2	
CADMIUM	,00	,00	,00	
CHROMIUM	,01	,01	<,01	
COPPER	,07	,00	,01	
IRON, TOTAL	,11	4,50	,01	
MANGANESE	<,01	,10	,68	
NICKEL	,08	,00	,00	
LEAD	,00	,30	<,10	
ZINC	,00	,00	,00	
BARIUM	<,10	<,10	,20	
BERYLLIUM	,00	,00	,00	
COBALT	,00	,00	,00	
MOLYBDENUM	,00	,00	,00	
TIN	,00	<1,00	,00	
VANADIUM	,00	,00	,00	

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-2 , IN

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	SUMP DSCHG	GW SEEP 1	GW SEEP 2	
FLUORIDE	4.3000	.3100	.1400	
CYANIDE	.0600	.2700	.0100	
PHENOLS	.0300	.1800	.0100	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	.2100	5.8000	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	.0400	.0200	.0500	
SULFATE	150.000	320.000	150.000	
CALCIUM	21.000	3.000	230.000	
MAGNESIUM	47.000	1.400	57.000	
CHLORIDE	9.000	38.000	219.000	
PHOSPHATE	.140	1.500	.040	
POTASSIUM	1100.000	21.000	10.000	
SODIUM	1700.000	2600.000	62.000	

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-2 , IN

SAMPLE SUMP DSCHG

ORGANICS GROUP RESULTS, MG/L

PCBS
UNIDENTIFIED ELECTRONEGATIVE COMPOUND .003

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:.01 & .03, LIGHT VOLATILES:<1

REMARKS

NOTED RIVER INFLOW INTO SUMP

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 400 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-2 , IN

SAMPLE GW SEEP 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:.06,LIGHT VOLATILES:<1

REMARKS

SEEP FED BY CAUSTIC PIT (DETINNING PROCESS)

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 120 FT

21

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-2 , IN

SAMPLE GW SEEP 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 600 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-3 , IN

SAMPLE NO.	SPRING	WELL 1	WELL 2 BKG	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/11/76	11/11/76	11/11/76	
TIME	11:40	14:15	12:45	
TEMPERATURE	86.0	13.5	96.0	
PH	6.8	7.0	7.3	
SPECIFIC CONDUCTANCE	1100	650	560	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.005	.250	.010
BARIUM	.030	.100	.003
CALCIUM	50.000	50.000	50.000
IRON	.200	.250	.030
MAGNESIUM	8.000	8.000	5.000
MANGANESE	.030	.350	.005
POTASSIUM	<.100	<.100	<.100
SILICA	1.000	2.000	2.000
SODIUM	.200	3.000	.200
STRONTIUM	.250	.250	.500
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.003	.003	.003
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.002	.002	.002
COBALT	<.001	.005	.003
COPPER	.003	.500	.050
LEAD	.001	.002	.001

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-3 , IN

SAMPLE NO.	SPRING	WELL 1	WELL 2 BKG	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	SPRING	WELL 1	WELL 2 BKG
MOLYBDENUM	<1.000	<1.000	<1.000
NICKEL	<.001	.002	.002
SILVER	.005	.010	.002
TIN	<1.000	<1.000	<1.000
TITANIUM	.002	.030	<.001
TUNGSTEN	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000
ZINC	<.001	<.001	.003
ZIRCONIUM	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

	SPRING	WELL 1	WELL 2 BKG
CADMIUM	.00	.00	.00
CHROMIUM	<.01	<.01	<.01
COPPER	1.10	.10	.13
IRON, TOTAL	.05	.69	.01
MANGANESE	.28	6.20	.01
NICKEL	.00	.00	.00
LEAD	<.10	.00	.00
ZINC	.00	.00	.00
BARIUM	<.10	<.10	<.10
BERYLLIUM	.00	.00	.00
COBALT	.00	.03	<.01
MOLYBDENUM	.00	.00	.00
TIN	.00	.00	.00
VANADIUM	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-3 , IN

SAMPLE NO.	SPRING	WELL 1	WELL 2 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1300	.1500	.1900	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0200	.0800	<.0010	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	30.000	20.000	20.000	
CALCIUM	110.000	180.000	90.000	
MAGNESIUM	40.000	36.000	29.000	
CHLORIDE	12.000	69.000	10.000	
PHOSPHATE	.080	.030	.070	
POTASSIUM	.820	1.100	.630	
SODIUM	4.900	16.000	3.200	

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-3 , IN

SAMPLE SPRING

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: .02, LIGHT VOLATILES: <1

REMARKS

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-3 , IN

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 1000 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-3 , IN

SAMPLE WELL 2 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 400 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE NO.	SPRING 1	SPRING 2	WELL 1	WELL 2
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	11/10/76	11/10/76	11/10/76	11/10/76
TIME	14:00	15:00	11:45	10:30
TEMPERATURE	17.0	76.0	12.0	13.0
PH	7.0	6.9	7.0	7.1
SPECIFIC CONDUCTANCE	3400	900	750	650
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.350	.050	.050	.003
BARIUM	.200	.001	.030	.150
CALCIUM	50.000	50.000	50.000	50.000
IRON	.200	.050	.080	.005
MAGNESIUM	8.000	5.000	5.000	5.000
MANGANESE	.030	.005	.010	.001
POTASSIUM	3.000	<.100	<.100	<.100
SILICA	2.000	1.000	1.000	1.000
SODIUM	10.000	3.000	5.000	.500
STRONTIUM	.500	.250	1.000	3.000
ANTIMONY	<1.000	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.100	.005	.003	.003
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.005	.001	.001	.002
COBALT	.002	<.001	<.001	<.001
COPPER	.005	.001	.002	.030
LEAD	.002	.001	.001	.002

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE NO.	SPRING 1	SPRING 2	WELL 1	WELL 2
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT,)				
MOLYBDENUM	<1,000	<1,000	<1,000	<1.000
NICKEL	,002	<,001	<,001	<,001
SILVER	,002	,001	,002	,002
TIN	<1,000	<1,000	<1,000	<1,000
TITANIUM	,002	,002	,003	<,001
TUNGSTEN	<1,000	<1,000	<1,000	<1,000
VANADIUM	<1.000	<1,000	<1,000	<1,000
ZINC	<,001	<,001	,002	<,001
ZIRCONIUM	<1,000	<1,000	<1,000	<1,000
GERMANIUM	<1.000	<1,000	<1,000	<1,000
TELLURIUM	<1,000	<1,000	<1,000	<1,000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	,00	.00	,00	,00
CHROMIUM	,01	<,01	<,01	<,01
COPPER	<,01	<,01	<,01	<,01
IRON, TOTAL	.27	,05	.01	,08
MANGANESE	1.50	,13	,04	,00
NICKEL	,03	,00	,00	,00
LEAD	,00	<,10	<,10	<,10
ZINC	,00	.00	,00	.00
BARIUM	.20	,10	<,10	,10
BERYLLIUM	,00	,00	,00	,00
COBALT	,00	,00	,00	,00
MOLYBDENUM	,00	,00	,00	,00
TIN	,00	,00	,00	,00
VANADIUM	,00	.00	,00	,00

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ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE NO.	SPRING 1	SPRING 2	WELL 1	WELL 2
		G4 AND G5 GROUP RESULTS, MG/L		
FLUORIDE	.2300	.1700	.3100	.8600
CYANIDE	.0100	<.0050	<.0050	<.0050
PHENOLS	.0050	.0200	.0030	.0050
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	<.0100	.0500	.0100	.0100
SULFATE	20.000	70.000	60.000	55.000
CALCIUM	200.000	150.000	130.000	98.000
MAGNESIUM	78.000	19.000	17.000	35.000
CHLORIDE	55.000	108.000	102.000	97.000
PHOSPHATE	.150	.010	.050	.050
POTASSIUM	140.000	2.300	2.400	1.300
SODIUM	440.000	20.000	24.000	11.000

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE SPRING 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SEEPS DIRECTLY FROM FILL, MAY BE CONSIDERED LEACHATE

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 0 FT

265

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE SPRING 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED WASTE POSSIBLY CONTAINING PCBS

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 800 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED WASTE POSSIBLY CONTAINING PCBS

SAMPLE TURBID

TOTAL WELL DEPTH: 6 FT

DISTANCE FROM DISPOSAL AREA: 1300 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED WASTE POSSIBLY CONTAINING PCBS

SAMPLE CLEAR

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE NO.	WELL 3	WELL 4 BKG		
DISPOSAL TYPE	LANDFILL	LANDFILL		
WATER TYPE	GROUND	GROUND		
DATE SAMPLED	11/10/76	11/10/76		
TIME	11:30	12:30		
TEMPERATURE	12.0	13.0		
PH	7.0	7.1		
SPECIFIC CONDUCTANCE	590	530		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 3	WELL 4 BKG
ALUMINUM	.003	.100
BARIUM	.001	.010
CALCIUM	50.000	50.000
IRON	.050	.150
MAGNESIUM	8.000	8.000
MANGANESE	.002	.005
POTASSIUM	<.100	<.100
SILICA	1.000	2.000
SODIUM	.250	.500
STRONTIUM	3.000	3.000
ANTIMONY	<1.000	<1.000
ARSENIC	<1.000	<1.000
BERYLLIUM	<1.000	<1.000
BISMUTH	<1.000	<1.000
BORON	.005	.010
CADMIUM	<1.000	<1.000
CHROMIUM	.002	.003
COBALT	<.001	<.001
COPPER	.005	.003
LEAD	.002	.001

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE NO.	WELL 3	WELL 4 BKG		

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1,000	<1,000
NICKEL	<,001	,003
SILVER	.001	,002
TIN	<1.000	<1,000
TITANIUM	.001	,002
TUNGSTEN	<1.000	<1,000
VANADIUM	<1.000	<1.000
ZINC	<,001	,002
ZIRCONIUM	<1,000	<1,000
GERMANIUM	<1.000	<1,000
TELLURIUM	<1,000	<1,000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	,00	,00
CHROMIUM	<,01	<,01
COPPER	<,01	<,01
IRON, TOTAL	,05	<,01
MANGANESE	,01	,01
NICKEL	,00	<,03
LEAD	<,10	,00
ZINC	,00	,00
BARIUM	<,10	<,10
BERYLLIUM	,00	,00
COBALT	,00	,00
MOLYBDENUM	,00	,00
TIN	,00	,00
VANADIUM	,00	,00

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE NO.	WELL 3	WELL 4 BKG		
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	1.9000	1.9000		
CYANIDE	<.0050	<.0050		
PHENOLS	.0700	<.0010		
MERCURY	<.0005	<.0005		
ARSENIC	<.0300	<.0300		
CHROMIUM+6	<.0100	<.0100		
SELENIUM	.0100	.0100		
SULFATE	70.000	75.000		
CALCIUM	69.000	61.000		
MAGNESIUM	44.000	41.000		
CHLORIDE	9.000	8.000		
PHOSPHATE	.030	.050		
POTASSIUM	.950	.910		
SODIUM	3.900	4.200		

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-4 , IN

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
.003 AS PCB'S

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED WASTE POSSIBLY CONTAINING PCBS

SAMPLE CLEAR

TOTAL WELL DEPTH: 160 FT

DISTANCE FROM DISPOSAL AREA: 1200 FT

ANALYSIS OF WATER SAMPLES FROM
INDIANA S-4 , IN

SAMPLE WELL 4 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED WASTE POSSIBLY CONTAINING PCBS

SAMPLE CLEAR

TOTAL WELL DEPTH: 79 FT

DISTANCE FROM DISPOSAL AREA: 1500 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE NO.	WELL 3	WELL 2	WELL 1	WELL 4 BKG
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	11/9/76	11/9/76	11/9/76	11/9/76
TIME	17:15	16:25	18:15	16:55
TEMPERATURE	12.0	12.0		11.5
PH	6.8	7.2	7.2	7.4
SPECIFIC CONDUCTANCE	3200	850	510	700
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.010	.005	.020	.200
BARIUM	.300	.010	.350	.050
CALCIUM	50.000	50.000	50.000	50.000
IRON	.150	.150	.500	.150
MAGNESIUM	5.000	5.000	10.000	8.000
MANGANESE	.020	.010	.020	.020
POTASSIUM	.250	<.100	.250	.100
SILICA	1.000	1.000	2.000	2.500
SODIUM	5.000	.250	3.000	2.000
STRONTIUM	.500	.500	3.000	.500
ANTIMONY	<1.000	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.050	.005	.020	.010
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.002	.003	.003	.003
COBALT	<.001	<.001	.003	.003
COPPER	.002	.001	.010	.002
LEAD	.001	.001	.002	.002

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE NO.	WELL 3	WELL 2	WELL 1	WELL 4 BKG
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1,000	<1,000	<1,000	<1,000
NICKEL	,001	.003	.003	.001
SILVER	.001	,001	.001	,002
TIN	<1,000	<.001	<,001	<1,000
TITANIUM	<.001	,003	,002	,002
TUNGSTEN	<1,000	<1,000	<1,000	<1,000
VANADIUM	<1,000	<1,000	<1,000	<1,000
ZINC	<.001	,001	,002	<,001
ZIRCONIUM	<1,000	<1,000	<1,000	<1,000
GERMANIUM	<1,000	<1,000	<1,000	<1,000
TELLURIUM	<1,000	<1,000	<1,000	<1,000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	,00	.00	,00	.00
CHROMIUM	,01	<,01	<,01	<,01
COPPER	<,01	<.01	<,01	<,01
IRON, TOTAL	.01	<.01	<,01	,01
MANGANESE	.26	,28	,03	,33
NICKEL	<,03	<,01	,00	,00
LEAD	.00	.00	,00	,00
ZINC	,00	,00	,00	,00
BARIUM	1,10	,10	,20	.10
BERYLLIUM	,00	,00	,00	,00
COBALT	.00	.00	<,01	<,01
MOLYBDENUM	,00	.00	,00	,00
TIN	.00	,00	,00	,00
VANADIUM	,00	,00	,00	,00

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE NO.	WELL 3	WELL 2	WELL 1	WELL 4 BKG
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.4900	.5400	1.2000	1.1000
CYANIDE	<.0050	.0070	.0300	<.0050
PHENOLS	.0060	.0090	.0020	.0040
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	<.0100	<.0100	<.0100	<.0100
SULFATE	12.000	150.000	20.000	30.000
CALCIUM	370.000	150.000	72.000	92.000
MAGNESIUM	120.000	42.000	34.000	33.000
CHLORIDE	64.000	38.000	27.000	36.000
PHOSPHATE	.160	.070	.050	.210
POTASSIUM	13.000	1.600	2.200	1.200
SODIUM	310.000	6.100	16.000	25.000

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL WASTE

SAMPLE FAIRLY CLEAR

MONITOR WELL 3

TOTAL WELL DEPTH: 12 FT

DISTANCE FROM DISPOSAL AREA: 200 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL WASTE

SAMPLE CLEAR

MONITOR WELL 2

TOTAL WELL DEPTH: 13 FT

DISTANCE FROM DISPOSAL AREA: 700 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL WASTE

SAMPLE CLEAR

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 400 FT

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , TN

SAMPLE WELL 4 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL WASTE

SAMPLE FAIRLY CLEAR

MONITOR WELL 4, BACKGROUND

TOTAL WELL DEPTH: 14 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

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              ANALYSIS OF WATER SAMPLES FROM

                   INDIANA S-5     , IN


SAMPLE NO.   WELL 5
             ----------  ----------  ----------  ----------


DISPOSAL
 TYPE         LANDFILL
WATER TYPE    GROUND
DATE SAMPLED  11/9/76
TIME              15:00
TEMPERATURE       12.0
PH                 7.4
SPECIFIC
 CONDUCTANCE    440
DISSOLVED
 OXYGEN

 EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT
                         PERCENT



 ALUMINUM          1.000
 BARIUM             .010
 CALCIUM          50.000
 IRON               .350
 MAGNESIUM         8.000

 MANGANESE          .200
 POTASSIUM         <.100
 SILICA            5.000
 SODIUM             .250
 STRONTIUM          .500

 ANTIMONY         <1.000
 ARSENIC          <1.000
 BERYLLIUM        <1.000
 BISMUTH          <1.000
 BORON              .020

 CADMIUM          <1.000
 CHROMIUM           .010
 COBALT             .002
 COPPER             .010
 LEAD               .002
```

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE NO.	WELL 5

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000
NICKEL	.005
SILVER	.005
TIN	<.001
TITANIUM	.020
TUNGSTEN	<1.000
VANADIUM	<1.000
ZINC	<.001
ZIRCONIUM	<1.000
GERMANIUM	<1.000
TELLURIUM	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00
CHROMIUM	<.01
COPPER	<.01
IRON, TOTAL	.02
MANGANESE	1.30
NICKEL	<.01
LEAD	.00
ZINC	.00
BARIUM	<.10
BERYLLIUM	.00
COBALT	.00
MOLYBDENUM	.00
TIN	.00
VANADIUM	.00

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE NO. WELL 5
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G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	.3600
CYANIDE	<.0050
PHENOLS	.0090
MERCURY	<.0005
ARSENIC	<.0300
CHROMIUM+6	<.0100
SELENIUM	<.0100
SULFATE	50.000
CALCIUM	71.000
MAGNESIUM	17.000
CHLORIDE	13.000
PHOSPHATE	.070
POTASSIUM	.540
SODIUM	6.900

ANALYSIS OF WATER SAMPLES FROM

INDIANA S-5 , IN

SAMPLE WELL 5

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: .03, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INDUSTRIAL WASTE

MONITOR WELLS

TOTAL WELL DEPTH: 10 FT

DISTANCE FROM DISPOSAL AREA: 800 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-1 , MA

SAMPLE NO.	WELL 2	----------	----------	----------
DISPOSAL TYPE	LANDFILL			
WATER TYPE	GROUND			
DATE SAMPLED	11/4/76			
TIME	11:30			
TEMPERATURE	16.0			
PH	6.2			
SPECIFIC CONDUCTANCE	2000			
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.100
BARIUM	.001
CALCIUM	50.000
IRON	.010
MAGNESIUM	15.000
MANGANESE	.100
POTASSIUM	5.000
SILICA	1.500
SODIUM	15.000
STRONTIUM	.500
ANTIMONY	<1.000
ARSENIC	<1.000
BERYLLIUM	<1.000
BISMUTH	<1.000
BORON	.100
CADMIUM	<1.000
CHROMIUM	.002
COBALT	<1.000
COPPER	.005
LEAD	.002

ANALYSIS OF WATER SAMPLES FROM

MASS, S-1 , MA

SAMPLE NO.	WELL 2			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000
NICKEL	.001
SILVER	.001
TIN	<1.000
TITANIUM	.003
TUNGSTEN	<1.000
VANADIUM	<1.000
ZINC	.003
ZIRCONIUM	<1.000
GERMANIUM	<1.000
TELLURIUM	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00
CHROMIUM	.01
COPPER	.04
IRON, TOTAL	3.00
MANGANESE	1.10
NICKEL	.00
LEAD	<.10
ZINC	.97
BARIUM	.00
BERYLLIUM	.00
COBALT	.00
MOLYBDENUM	.00
TIN	.00
VANADIUM	.00

ANALYSIS OF WATER SAMPLES FROM

MASS. S-1 , MA

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 2			
FLUORIDE	1.2000			
CYANIDE	<.0050			
PHENOLS	.0070			
MERCURY	<.0005			
ARSENIC	<.0300			
CHROMIUM+6	<.0100			
SELENIUM	.0700			
SULFATE	25.000			
CALCIUM	190.000			
MAGNESIUM	17.000			
CHLORIDE	2.000			
PHOSPHATE	4.100			
POTASSIUM	94.000			
SODIUM	250.000			

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ANALYSIS OF WATER SAMPLES FROM

MASS. S-1 , MA

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES:<1

REMARKS

STRONG LEACHATE (VOLATILES) ODOR

SITE ACCEPTED PLASTIC RESINS

SAMPLE CLEAR

MONITOR WELL 2,LEACHATE

TOTAL WELL DEPTH: 11 FT

DISTANCE FROM DISPOSAL AREA: 70 FT

2

ANALYSIS OF WATER SAMPLES FROM

MASS. S-2 , MA

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	
DISPOSAL TYPE	COMB	COMB	COMB	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/3/76	11/3/76	11/3/76	
TIME	13:00	15:30	10:30	
TEMPERATURE	13.0	13.0	16.0	
PH	6.5	6.1	6.4	
SPECIFIC CONDUCTANCE	125	2500	250	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 2	WELL 3 BKG
ALUMINUM	.300	.010	.200
BARIUM	.030	.030	.002
CALCIUM	50.000	50.000	50.000
IRON	1.000	5.000	.010
MAGNESIUM	2.000	5.000	5.000
MANGANESE	.010	.250	.050
POTASSIUM	.150	.500	.200
SILICA	20.000	1.000	2.000
SODIUM	3.000	10.000	15.000
STRONTIUM	1.000	1.000	1.000
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.005	.020	.005
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.010	.003	.005
COBALT	.001	.003	.001
COPPER	.003	.001	.003
LEAD	.001	<.001	.003

ANALYSIS OF WATER SAMPLES FROM

MASS. S-2 , MA

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<.001	<.001	.003	
NICKEL	.010	.002	.002	
SILVER	.002	.003	.002	
TIN	<1.000	<1.000	<1.000	
TITANIUM	.005	.001	.002	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	.003	<.001	.010	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	
CHROMIUM	.01	<.01	<.01	
COPPER	<.01	.00	<.01	
IRON, TOTAL	2.10	140.00	.10	
MANGANESE	.00	8.10	.15	
NICKEL	<.03	.04	.00	
LEAD	<.10	.00	<.10	
ZINC	.00	.00	.05	
BARIUM	<.10	.10	.00	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.08	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

MASS. S-2 , MA

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	
FLUORIDE	.1000	.1500	.1200	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0300	.0300	.0030	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	.6500	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	.0100	.0200	.0400	
SULFATE	6.600	1.700	18.000	
CALCIUM	22.000	190.000	21.000	
MAGNESIUM	4.600	47.000	3.300	
CHLORIDE	14.000	480.000	66.000	
PHOSPHATE	.060	.150	.009	
POTASSIUM	3.000	16.000	2.600	
SODIUM	5.500	160.000	37.000	

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ANALYSIS OF WATER SAMPLES FROM

MASS. S-2 , MA

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:2.1

REMARKS

SITE ACCEPTED ACID PICKLING WASTE FROM WIRE FACTORY

SAMPLE CLEAR WITH BROWNISH TINT

MONITOR WELL 1,LEACHATE

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-2 , MA

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:APX 1.0

REMARKS

SUDSY SURFACE, STRONG LEACHATE SMELL

SITE ACCEPTED ACID PICKLING WASTE FROM WIRE FACTORY

SAMPLE CLEAR

MONITOR WELL 2, LEACHATE

TOTAL WELL DEPTH: 13 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

ANALYSIS OF WATER SAMPLES FROM

MASS, S-2   , MA

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES: 2.5

REMARKS

SITE ACCEPTED ACID PICKLING WASTE FROM WIRE FACTORY

SAMPLE CLEAR

BACKGROUND

TOTAL WELL DEPTH: 14 FT

DISTANCE FROM DISPOSAL AREA: 400 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-3 , MA

SAMPLE NO.	WELL 1	WELL 2	WELL 3	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/18/76	11/18/76	11/18/76	
TIME				
TEMPERATURE	11.0	12.0	12.0	
PH	7.2	6.8	7.0	
SPECIFIC CONDUCTANCE	185	221	197	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 2	WELL 3
ALUMINUM	5.000	5.000	8.000
BARIUM	.030	.050	.100
CALCIUM	50.000	50.000	50.000
IRON	.250	.250	.250
MAGNESIUM	8.000	8.000	8.000
MANGANESE	.100	.100	.100
POTASSIUM	.250	.250	.350
SILICA	25.000	30.000	35.000
SODIUM	2.000	3.000	3.000
STRONTIUM	1.000	.250	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.010	.010	.010
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.020	.020	.020
COBALT	.001	.002	.002
COPPER	.010	.010	.020
LEAD	.002	.002	.002

ANALYSIS OF WATER SAMPLES FROM

MASS. S-3 , MA

SAMPLE NO.	WELL 1	WELL 2	WELL 3	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	WELL 1	WELL 2	WELL 3	
MOLYBDENUM	<1.000	<1.000	<1.000	
NICKEL	.003	.003	.003	
SILVER	.002	.002	.002	
TIN	<1.000	<1.000	<1.000	
TITANIUM	.100	.100	.200	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	.003	.003	.005	
ZINC	.002	.001	.001	
ZIRCONIUM	.002	<.002	<.002	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

	WELL 1	WELL 2	WELL 3	
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	<.01	
COPPER	.02	<.01	.10	
IRON, TOTAL	.18	.15	.91	
MANGANESE	1.30	.99	.56	
NICKEL	<.03	<.03	.00	
LEAD	.00	.00	.00	
ZINC	.00	.00	.00	
BARIUM	<.10	<.10	<.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.00	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	<.08	

ANALYSIS OF WATER SAMPLES FROM

MASS. S-3 , MA

SAMPLE NO.	WELL 1	WELL 2	WELL 3	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1000	.1100	.1200	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0200	.0100	.0900	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	3.300	4.200	8.300	
CALCIUM	30.000	35.000	20.000	
MAGNESIUM	8.900	9.200	4.600	
CHLORIDE	26.000	13.000	13.000	
PHOSPHATE	.190	.330	.590	
POTASSIUM	2.500	2.900	2.700	
SODIUM	8.100	11.000	7.000	

ANALYSIS OF WATER SAMPLES FROM

MASS, S-3 , MA

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
PCB'S & OTHER ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED >500,000 LB PCB WASTE

SAMPLE TURBID

TOTAL WELL DEPTH: 16 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

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ANALYSIS OF WATER SAMPLES FROM

MASS, S-3 , MA

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
PCB'S & OTHER ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
HEAVY ORGANICS:<,01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED >500,000 LB PCB WASTE

SAMPLE TURBID

TOTAL WELL DEPTH: 16 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

299

ANALYSIS OF WATER SAMPLES FROM
MASS. S-3 , MA

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
PCB'S & OTHER ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED >500,000 LB PCB WASTE

SAMPLE TURBID

TOTAL WELL DEPTH: 16 FT.

DISTANCE FROM DISPOSAL AREA: 50 FT.

ANALYSIS OF WATER SAMPLES FROM

MASS. S-4 , MA

SAMPLE NO.	WELL 1	WELL 2 BKG	WELL 3
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND
DATE SAMPLED	11/2/76	11/2/76	11/2/76
TIME	10:30	12:00	9 30
TEMPERATURE	10.0	13.0	9.0
PH	6.4	7.3	6.4
SPECIFIC CONDUCTANCE	5280	930	383
DISSOLVED OXYGEN			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT-PERCENT

ALUMINUM	.100	1.000	1.000
BARIUM	.030	.005	.005
CALCIUM	50.000	50.000	50.000
IRON	1.000	1.000	5.000
MAGNESIUM	10.000	10.000	8.000
MANGANESE	.200	.200	.150
POTASSIUM	.250	.100	.100
SILICA	2.000	8.000	20.000
SODIUM	5.000	5.000	1.000
STRONTIUM	.010	.100	.010
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.020	.003	.005
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.002	.002	.003
COBALT	<.001	.001	<.001
COPPER	.001	.003	.005
LEAD	.001	.001	.001

ANALYSIS OF WATER SAMPLES FROM

MASS, S-4 , MA

SAMPLE NO.	WELL 1	WELL 2BKG	WELL 3	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1,000	<1,000	<1.000	
NICKEL	.001	.005	.020	
SILVER	,001	,002	.001	
TIN	<1,000	<1,000	<1.000	
TITANIUM	.003	,010	,010	
TUNGSTEN	<1,000	<1.000	<1,000	
VANADIUM	<1,000	<1.000	<1,000	
ZINC	,001	,002	.003	
ZIRCONIUM	<1,000	<1,000	<1,000	
GERMANIUM	<1,000	<1,000	<1,000	
TELLURIUM	<1,000	<1.000	<1,000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	,00	,00	
CHROMIUM	.01	<,01	<,01	
COPPER	,00	<,01	<,01	
IRON, TOTAL	19.00	,02	,02	
MANGANESE	5.50	1,20	,57	
NICKEL	,05	<,03	<,03	
LEAD	<,10	.00	,00	
ZINC	.00	,00	,00	
BARIUM	.10	<,10	<,10	
BERYLLIUM	,00	,00	,00	
COBALT	,00	,00	,00	
MOLYBDENUM	,00	,00	,00	
TIN	,00	,00	,00	
VANADIUM	,00	,00	,00	

ANALYSIS OF WATER SAMPLES FROM

MASS. S-4 , MA

SAMPLE NO.	WELL 1	WELL 2 BKG	WELL 3	

G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	.2400	.2200	<.0200
CYANIDE	<.0050	<.0050	<.0050
PHENOLS	.0100	.0100	.0100
MERCURY	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100
SELENIUM	.0800	.0400	.1300
SULFATE	4.200	12.000	12.000
CALCIUM	260.000	112.000	41.000
MAGNESIUM	340.000	44.000	13.000
CHLORIDE	<2.000	105.000	13.000
PHOSPHATE	.100	.009	.010
POTASSIUM	69.000	1.800	1.600
SODIUM	180.000	46.000	6.700

ANALYSIS OF WATER SAMPLES FROM

MASS. S-4 , MA

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANIC:<.01,LIGHT VOLATILES:ONE PEAK APX 1.2

REMARKS

STRONG ORGANIC DECOMPOSITION ODOR

SITE ACCEPTED PCB'S

SAMPLE CLEAR

MONITORING WELL 1, LEACHATE

TOTAL WELL DEPTH: 15 FT

DISTANCE FROM DISPOSAL AREA: 70 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-4 , MA

SAMPLE WELL 2 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:ONE PEAK APX 1.0

REMARKS

MODERATE LEACHATE ODOR

SITE ACCEPTED PCB'S

SAMPLE CLEAR

MONITORING WELL 2,. BACKGROUND

TOTAL WELL DEPTH: 32 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-4 , MA

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:TWO PEAKS APX 10.3 & 5.6

REMARKS

SITE ACCEPTED PCB'S

SAMPLE VERY CLEAR

TOTAL WELL DEPTH: 15 FT

DISTANCE FROM DISPOSAL AREA: 1000 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-5 , MA

SAMPLE NO.	WELL 1	WELLS 2&3	WELL 4 BKG	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/1/76	11/1/76	11/1/76	
TIME	10:00	11:00	15:30	
TEMPERATURE	11.4	15.0	22.0	
PH	6.5	6.6	6.6	
SPECIFIC CONDUCTANCE	500	600	346	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	3.000	.500	1.000
BARIUM	.200	.200	.100
CALCIUM	50.000	50.000	50.000
IRON	5.000	5.000	1.000
MAGNESIUM	5.000	8.000	10.000
MANGANESE	.250	.250	.250
POTASSIUM	.200	.200	.250
SILICA	20.000	20.000	10.000
SODIUM	1.000	3.500	3.500
STRONTIUM	.500	.500	.500
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.030	.030	.010
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.010	.003	.005
COBALT	.003	<.001	.001
COPPER	.005	.005	.010
LEAD	.003	.001	.010

ANALYSIS OF WATER SAMPLES FROM

MASS, S-5 , MA

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO,	WELL 1	WELLS 2&3	WELL 4 BKG	
MOLYBDENUM	<1,000	<1,000	<1,000	
NICKEL	,010	.002	.003	
SILVER	,002	,001	,001	
TIN	<1,000	<1,000	<1,000	
TITANIUM	,050	,010	,005	
TUNGSTEN	<1,000	<1,000	<1,000	
VANADIUM	<1,000	<1,000	<1,000	
ZINC	,003	,003	,001	
ZIRCONIUM	<1,000	<1,000	<1,000	
GERMANIUM	<1,000	<1,000	<1,000	
TELLURIUM	<1,000	<1,000	<1,000	

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO,	WELL 1	WELLS 2&3	WELL 4 BKG	
CADMIUM	,00	,00	,00	
CHROMIUM	,01	,01	,01	
COPPER	<,01	,18	<,01	
IRON, TOTAL	22,00	16,00	,04	
MANGANESE	2,40	4.00	1,30	
NICKEL	<,03	<,03	,00	
LEAD	,00	,00	<,10	
ZINC	,00	.00	,00	
BARIUM	,20	,10	<,10	
BERYLLIUM	,00	,00	,00	
COBALT	,00	,00	,00	
MOLYBDENUM	,00	,00	,00	
TIN	,00	,00	,00	
VANADIUM	,00	,00	,00	

ANALYSIS OF WATER SAMPLES FROM

MASS, S-5 , MA

SAMPLE NO.	WELL 1	WELLS 2&3	WELL 4 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1200	.1800	.1300	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0070	.0070	.0600	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	.0300	.0200	.0300	
SULFATE	5.000	12.000	35.000	
CALCIUM	65.000	68.000	55.000	
MAGNESIUM	8.900	12.000	12.000	
CHLORIDE	37.000	65.000	15.000	
PHOSPHATE	.080	.080	.030	
POTASSIUM	5.000	6.200	2.700	
SODIUM	17.000	32.000	18.000	

ANALYSIS OF WATER SAMPLES FROM

MASS. S-5 , MA

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES:<1

REMARKS

SLIGHT ORGANIC LEACHATE ODOR

SAMPLE SLIGHTLY TURBID

LEACHATE

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 800 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-5 , MA

SAMPLE WELLS 2&3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES:<1,ONE PEAK APX 1.0

REMARKS

STRONG LEACHATE ODOR

SAMPLE CLEAR WITH SLIGHT DISCOLORATION,DARKENED WHILE STANDING

LEACHATE,COMPOSITE SAMPLE OF WELLS 2 & 3

TOTAL WELL DEPTH: 15 FT AND 15 FT

DISTANCE FROM DISPOSAL AREA: 200 FT AND 200 FT

ANALYSIS OF WATER SAMPLES FROM

MASS. S-5 , MA

SAMPLE WELL 4 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:ONE PEAK APX 2.1

REMARKS

SAMPLE SLIGHTLy TURBID

BACKGROUND

TOTAL WELL DEPTH: 15 FT

DISTANCE FROM DISPOSAL AREA: 1400 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE NO,	WELL 1	WELL 2	WELL 3	WELL 4 BKG
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	9/30/76	9/29/76	9/30/76	9/30/76
TIME	14:15	11:20	12:10	13:40
TEMPERATURE	12,2	17,4	13,6	16,2
PH	7.6	9,4	9,1	7.6
SPECIFIC CONDUCTANCE	580	7500	4400	390
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	,050	,005	.000	,050
BARIUM	,010	<,001	.000	,010
CALCIUM	50,000	15,000	.000	50,000
IRON	,100	,003	.000	,050
MAGNESIUM	25.000	,010	.000	20.000
MANGANESE	,010	,001	.000	,003
POTASSIUM	,250	.200	,000	<,100
SILICA	10,000	1,000	,000	10,000
SODIUM	8,000	50.000	,000	3,000
STRONTIUM	.250	,003	,000	.250
ANTIMONY	<1,000	<1,000	,000	<1,000
ARSENIC	<1,000	<1,000	,000	<1,000
BERYLLIUM	<1,000	<1.000	,000	<1,000
BISMUTH	<1,000	<1,000	,000	<1,000
BORON	,010	,003	,000	,010
CADMIUM	<1,000	<1.000	,000	<1,000
CHROMIUM	.030	,010	,000	,003
COBALT	.001	.002	.000	,001
COPPER	.010	.030	,000	,020
LEAD	.001	.002	,000	,002

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4 BKG
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	.002	.005	.000	.002
NICKEL	.010	.005	.000	.005
SILVER	.002	.005	.000	.002
TIN	<.002	<.001	.000	.001
TITANIUM	.002	.001	.000	.002
TUNGSTEN	<1.000	<1.000	.000	<1.000
VANADIUM	<.001	<.001	.000	.002
ZINC	.001	.001	.000	.001
ZIRCONIUM	<1.000	<1.000	.000	<1.000
GERMANIUM	<1.000	<1.000	.000	<1.000
TELLURIUM	<1.000	<1.000	.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	.05	.36	.00	<.01
COPPER	<.01	2.80	.00	<.01
IRON, TOTAL	.02	.00	.00	<.01
MANGANESE	.00	.00	.00	.00
NICKEL	<.03	.67	.00	<.03
LEAD	.00	<.10	.00	<.10
ZINC	.00	.00	.00	.00
BARIUM	<.10	.00	.00	<.10
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	.05	.00	.00
MOLYBDENUM	<.03	.15	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4 BKG
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.1700	3.8000	5.0000	.0100
CYANIDE	.6300	14.0000	.3500	<.0050
PHENOLS	.0400	.0400	.0300	.0200
MERCURY	<.0005	.0008	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	.0100	<.0100	<.0100
SELENIUM	<.0100	.0800	<.0100	<.0100
SULFATE	32.000	390.000	390.000	24.000
CALCIUM	58.000	4.000	5.600	39.000
MAGNESIUM	25.000	.250	1.100	15.000
CHLORIDE	34.000	20.000	755.000	10.000
PHOSPHATE	.320	.870	.670	.040
POTASSIUM	3.300	10.000	3.100	1.400
SODIUM	14.000	13.000	910.000	11.000

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED LIQUID METAL PLATING WASTE WITH ZN,CR,CN

SAMPLE CLEAR

WELL THOUGHT TO CONTAIN TRACES OF PLANT EFFLUENT (PO4,ZN,DICHROMATE)

TOTAL WELL DEPTH: 75 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

31

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

SMOKING REACTION UPON FILLING FIXED METAL BOTTLES WITH SAMPLE

SITE ACCEPTED LIQUID METAL PLATING WASTE WITH ZN,CR,CN

SAMPLE APPEARED FOAMY,LIGHT BROWN TINT

MONITOR WELL 2

TOTAL WELL DEPTH: 66 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES

REMARKS

SMOKING REACTION UPON FILLING FIXED METALS BOTTLES WITH SAMPLE

SITE ACCEPTED LIQUID METAL PLATING WASTE WITH ZN,CR,CN

SAMPLE FOAMED AT HYDRANT, SLIGHT BROWN TINT

MONITOR WELL 3

TOTAL WELL DEPTH: 66 FT

DISTANCE FROM DISPOSAL AREA: 150 FT

31

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-1 , MI

SAMPLE WELL 4 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED LIQUID METAL PLATING WASTE WITH ZN,CR,CN

SAMPLE CLEAR

BACKGROUND

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 1000 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-2 , MI

SAMPLE NO.	WELL 3 BKG	WELL 1	WELL 2	
DISPOSAL TYPE	DRY WL/LGN	DRY WL/LGN	DRY WL/LGN	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	9/29/76	9/29/76	9/29/76	
TIME	12:00	9 25	9 45	
TEMPERATURE	13.9	10.6	11.1	
PH	7.6	8.0	7.8	
SPECIFIC CONDUCTANCE	470	495	500	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.005	.010	.030
BARIUM	.001	.005	.001
CALCIUM	50.000	50.000	50.000
IRON	.050	.050	.100
MAGNESIUM	10.000	10.000	15.000
MANGANESE	.020	.020	.030
POTASSIUM	.000	.000	.000
SILICA	8.000	8.000	10.000
SODIUM	.500	1.000	.750
STRONTIUM	.080	.100	.100
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.001	.005	.002
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.001	.002	.002
COBALT	<1.000	<1.000	<1.000
COPPER	.020	.005	.005
LEAD	<1.000	<1.000	<1.000

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-2 , MI

SAMPLE NO.	WELL 3 BKG	WELL 1	WELL 2	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000	<1.000	<1.000
NICKEL	<.001	.002	.005
SILVER	.005	.001	.001
TIN	<1.000	<1.000	<1.000
TITANIUM	<.001	<.001	.001
TUNGSTEN	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000
ZINC	.002	<.001	.001
ZIRCONIUM	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00
CHROMIUM	<.01	<.01	<.01
COPPER	<.01	<.01	<.01
IRON, TOTAL	.95	1.50	.55
MANGANESE	.01	.00	.01
NICKEL	.00	<.01	.01
LEAD	.00	.00	.00
ZINC	.00	.00	.00
BARIUM	<.10	.10	<.10
BERYLLIUM	.00	.00	.00
COBALT	.00	.00	.00
MOLYBDENUM	.00	.00	.00
TIN	.00	.00	.00
VANADIUM	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-2 , MI

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 3 BKG	WELL 1	WELL 2	
FLUORIDE	.1900	.2800	.1900	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0050	.0030	.0030	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	.0100	<.0100	
SULFATE	50.000	15.000	33.000	
CALCIUM	62.000	66.000	71.000	
MAGNESIUM	24.000	25.000	25.000	
CHLORIDE	1.000	1.000	1.000	
PHOSPHATE	.030	.030	.030	
POTASSIUM	.650	.940	1.200	
SODIUM	2.400	5.800	4.200	

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ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-2 , MI

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED TREATED ACID PICKLE LIQUOR WITH FE, OIL,TRACE CN

BACKGROUND

IRON STAIN ON MEMBRANE FILTER

TOTAL WELL DEPTH: 85 FT

DISTANCE FROM DISPOSAL AREA: 1800 FT

ANALYSIS OF WATER SAMPLES FROM
MICHIGAN S-2 , MI

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED TREATED ACID PICKLE LIQUOR WITH FE, OIL,TRACE CN

SAMPLE CLEAR

TOTAL WELL DEPTH: 90 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

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ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-2 . , MI

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED TREATED ACID PICKLE LIQUOR WITH FE, OIL,TRACE CN

SAMPLE TINTED YELLOW (COATING CORROSION FROM STORAGE TANK?)

IRON PARTICLES RETAINED ON PRE-FILTER

TOTAL WELL DEPTH: 90 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE NO.	WELL 1	WELL 3 BKG	SUPPLY W.	NORTH WELL
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	10/4/76	10/4/76	10/4/76	10/4/76
TIME	11:30	13:30	13:20	14:30
TEMPERATURE	13.2	11.4	86.0	96.0
PH	7.2	7.4	7.6	7.6
SPECIFIC CONDUCTANCE	1300	625	390	400
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 3 BKG	SUPPLY W.	NORTH WELL
ALUMINUM	.050	.050	.003	.050
BARIUM	.005	.050	.002	.003
CALCIUM	50.000	50.000	50.000	50.000
IRON	.050	.010	.030	.050
MAGNESIUM	15.000	20.000	15.000	20.000
MANGANESE	.010	.003	.003	.005
POTASSIUM	1.000	5.000	<.100	<.100
SILICA	5.000	5.000	8.000	10.000
SODIUM	8.000	10.000	2.000	3.000
STRONTIUM	.250	.250	.250	.250
ANTIMONY	<.005	<.005	<.005	<.005
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.001	.030	.003	.003
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.002	.010	.002	.005
COBALT	.002	.050	.001	<.001
COPPER	.005	.010	.010	.005
LEAD	.003	.010	.001	.002

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE NO.	WELL 1	WELL 3 BKG	SUPPLY W.	NORTH WELL

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	WELL 1	WELL 3 BKG	SUPPLY W.	NORTH WELL
MOLYBDENUM	.002	.002	.002	.002
NICKEL	.003	.003	.002	.002
SILVER	.005	.003	.003	.003
TIN	<.001	<.001	.250	<.001
TITANIUM	.002	.002	.002	.001
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000	<1.000
ZINC	.150	.150	.001	.002
ZIRCONIUM	<1.000	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 3 BKG	SUPPLY W.	NORTH WELL
CADMIUM	.00	.00	.00	.00
CHROMIUM	.00	.01	<.01	<.01
COPPER	<.01	<.01	<.01	.03
IRON, TOTAL	1.60	.00	.01	<.01
MANGANESE	.23	.00	<.01	.01
NICKEL	.03	.00	.03	<.03
LEAD	.00	<.10	.00	.00
ZINC	31.00	6.10	.00	.00
BARIUM	.10	.10	<.10	<.10
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	<.01	.00	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE NO.	WELL 1	WELL 3 BKG	SUPPLY W.	NORTH WELL
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.2200	.1200	.1100	.1400
CYANIDE	<.0050	.0300	<.0050	.0600
PHENOLS	.0500	.0200	.0100	.0200
MERCURY	<.0005	<.0005	<.0005	.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	<.0100	<.0100	<.0100	<.0100
SULFATE	330.000	16.000	9.100	15.000
CALCIUM	193.000	101.000	58.000	58.000
MAGNESIUM	37.000	12.000	17.000	20.000
CHLORIDE	145.000	30.000	6.000	2.000
PHOSPHATE	.030	.140	<.003	.030
POTASSIUM	19.000	12.000	1.200	1.000
SODIUM	78.000	12.000	3.900	4.500

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ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED TREATED RINSE WATER FROM PICKLING SOLUTION PROCESS (COPPER & BRASS TUBING)

SAMPLE LIGHT BROWN

MONITOR WELL 1

NEW GALVANIZED IRON PIPE USED FOR WELL CASING MAY HAVE CAUSED HIGH ZN

TOTAL WELL DEPTH: 35 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED TREATED RINSE WATER FROM PICKLING SOLUTION

SAMPLE LIGHT BROWN

MONITOR WELL 3, BACKGROUND

SAMPLE FROM (GALVANIZED?) PRESSURE TANK

TOTAL WELL DEPTH: 38 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE SUPPLY W.

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES <1

REMARKS

SITE ACCEPTED TREATED RINSE WATER FROM PICKLING SOLUTION

SAMPLE CLEAR

TOTAL WELL DEPTH: 120 FT

DISTANCE FROM DISPOSAL AREA: 700 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-3 , MI

SAMPLE NORTH WELL

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001 .

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED TREATED RINSE WATER FROM PICKLING SOLUTION

SAMPLE CLEAR

TOTAL WELL DEPTH: 70 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-4 , MI

SAMPLE NO.	BOILER W.	SERVICE W.	NORTH WELL	
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	10/5/76	10/5/76	10/5/76	
TIME	14:00	13:30	10:30	
TEMPERATURE	13.9	10.2	15.7	
PH	7.5	7.6	7.3	
SPECIFIC CONDUCTANCE	460	440	2200	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.010	.030	.030
BARIUM	.010	.010	.005
CALCIUM	50.000	50.000	50.000
IRON	.050	.050	.005
MAGNESIUM	20.000	15.000	2.000
MANGANESE	.005	.005	.003
POTASSIUM	<.100	<.100	.200
SILICA	10.000	5.000	.250
SODIUM	3.000	.250	20.000
STRONTIUM	.250	.250	.250
ANTIMONY	<.005	<.005	<.005
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.003	.002	.003
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.002	.002	.001
COBALT	<.001	<.001	.010
COPPER	.005	.005	.005
LEAD	.002	.001	.001

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-4 , MI

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	BOILER W.	SERVICE W.	NORTH WELL	
MOLYBDENUM	.002	.002	.002	
NICKEL	.001	.002	.003	
SILVER	.003	.003	.001	
TIN	<.001	<.001	<.001	
TITANIUM	.001	.001	.001	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	<.001	<.001	<.001	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	BOILER W.	SERVICE W.	NORTH WELL
CADMIUM	.00	.00	.00
CHROMIUM	<.01	<.01	.00
COPPER	<.01	<.01	.02
IRON, TOTAL	.12	.08	.01
MANGANESE	.02	.01	.00
NICKEL	.00	<.03	.08
LEAD	<.10	.00	.00
ZINC	.00	.00	.00
BARIUM	<.10	<.10	<.10
BERYLLIUM	.00	.00	.00
COBALT	.00	.00	.17
MOLYBDENUM	.00	.00	<.03
TIN	.00	.00	.00
VANADIUM	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-4 , MI

SAMPLE NO.	BOILER W.	SERVICE W.	NORTH WELL	
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.1500	.1300	.1600	
CYANIDE	.0100	<.0050	.0100	
PHENOLS	.0100	.0100	.0200	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	.0100	
SULFATE	20.000	22.000	660.000	
CALCIUM	63.000	62.000	119.000	
MAGNESIUM	27.000	24.000	28.000	
CHLORIDE	2.000	3.000	70.000	
PHOSPHATE	.009	.020	.009	
POTASSIUM	.660	.750	6.200	
SODIUM	2.200	1.700	370.000	

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-4 , MI

SAMPLE BOILER W.

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED EFFLUENT CONTAINING MERCURY

SAMPLE CLEAR

TOTAL WELL DEPTH: 90 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-4 , MI

SAMPLE SERVICE W.

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED EFFLUENT CONTAINING MERCURY

SAMPLE CLEAR

TOTAL WELL DEPTH: 190 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-4 , MI

SAMPLE NORTH WELL

ORGANICS GROUP RESULTS, MG/L

PCBS
<,001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <,001

VOLATILES
HEAVY ORGANICS:<,01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED EFFLUENT CONTAINING MERCURY

SAMPLE SILTY

MONITOR WELL NORTH

TOTAL WELL DEPTH: 14 FT

DISTANCE FROM DISPOSAL AREA: 150 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-5 , MI

SAMPLE NO.	WELL 1 BKG	WELL 2	WELL 3	WELL 4
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	10/6/76	10/6/76	10/6/76	10/6/76
TIME	16:30	14:45	10:00	11:00
TEMPERATURE	10.8	12.1	14.0	12.9
PH	7.8	7.2	7.7	7.2
SPECIFIC CONDUCTANCE	250	530	3125	1750
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1 BKG	WELL 2	WELL 3	WELL 4
ALUMINUM	.050	1.000	.001	.002
BARIUM	.001	.005	<.001	<1.000
CALCIUM	50.000	50.000	50.000	50.000
IRON	.050	.030	.001	.020
MAGNESIUM	15.000	15.000	3.000	3.000
MANGANESE	.005	.150	.001	.030
POTASSIUM	<.100	3.000	.100	5.000
SILICA	10.000	10.000	.020	1.000
SODIUM	.500	10.000	20.000	15.000
STRONTIUM	.250	.250	.020	.250
ANTIMONY	<.005	<.005	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.010	.010	<.001	.100
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.010	.005	.001	.001
COBALT	.002	.002	.001	.001
COPPER	.010	.010	.005	.001
LEAD	.003	.003	.010	.001

ANALYSIS OF WATER SAMPLES FROM
MICHIGAN S-5 , MI

SAMPLE NO.	WELL 1 BKG	WELL 2	WELL 3	WELL 4

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	WELL 1 BKG	WELL 2	WELL 3	WELL 4
MOLYBDENUM	.002	.005	.002	.002
NICKEL	.003	.005	.001	.001
SILVER	.001	.003	.001	.001
TIN	<.001	<.001	.005	<1.000
TITANIUM	.002	.003	.001	<1.000
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<.001	<1.000
ZINC	.020	.010	.001	.001
ZIRCONIUM	<1.000	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	WELL 1 BKG	WELL 2	WELL 3	WELL 4
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	.00	<.01	<.01
COPPER	<.01	<.01	.07	.00
IRON, TOTAL	.04	.03	.00	5.90
MANGANESE	.00	1.90	<.01	.89
NICKEL	<.03	<.03	.02	.00
LEAD	<.10	.00	.00	<.10
ZINC	.80	2.90	.00	.00
BARIUM	.00	<.10	.00	.00
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	.00	<.01	<.01
MOLYBDENUM	.00	.00	.00	<.03
TIN	.00	.00	<1.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-5 , MI

SAMPLE NO.	WELL 1BKG	WELL 2	WELL 3	WELL 4
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1100	.8500	2.0000	2.1000
CYANIDE	<.0050	<.0050	<.0050	.0400
PHENOLS	.0200	.0300	.0100	.3400
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	<.0100	.0200	<.0100	<.0100
SULFATE	13.000	50.000	90.000	375.000
CALCIUM	32.000	64.000	41.000	114.000
MAGNESIUM	12.000	10.000	28.000	20.000
CHLORIDE	9.000	11.000	1321.000	64.000
PHOSPHATE	.020	.110	.010	.150
POTASSIUM	1.000	12.000	4.200	52.000
SODIUM	1.700	34.000	830.000	25.000

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ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-5 , MI

SAMPLE WELL 1 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1,APX .05 OF AN ORGANIC

REMARKS

SITE ACCEPTED LIQUID WASTE CONTAINING AL,CD,CR,CN,ZN

SAMPLE CLOUDY

MONITOR WELL 1, BACKGROUND

TOTAL WELL DEPTH: 46 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-5 , MI

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED LIQUID WASTE CONTAINING AL,CD,CR,CN,ZN

SAMPLE CLOUDY

MONITOR WELL 2

TOTAL WELL DEPTH: 45 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-5 , MI

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
CHLORINATED PHENOLS PRESENT IN QUANTITIES <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED LIQUID WASTE CONTAINING AL,CD,CR,CN,ZN

SAMPLE CLEAR

MONITOR WELL 3

TOTAL WELL DEPTH: 50 FT

DISTANCE FROM DISPOSAL AREA: 125 FT

ANALYSIS OF WATER SAMPLES FROM

MICHIGAN S-5 , MI

SAMPLE WELL 4

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
TOTAL OF .003 CHLORINATED PHENOLS

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SAMPLE SMELLS OF SULFUR AND/OR IRON (FUEL OIL?),FOAMED IN BUCKET,FOAMED UPON FILTRATION

SITE ACCEPTED LIQUID WASTE CONTAINING AL,CD,CR,CN,ZN

SAMPLE CLOUDY, LIGHT GREENISH TINT

MONITOR WELL 4

TOTAL WELL DEPTH: 50 FT

DISTANCE FROM DISPOSAL AREA: 75 FT

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP, S-1 , NH

SAMPLE NO.	BKG	WELL 2	WELL 3	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/8/76	11/8/76	11/8/76	
TIME	14:00	14:00	16:30	
TEMPERATURE	8.0	10.0	6.0	
PH	6.1	5.6	6.5	
SPECIFIC CONDUCTANCE	400	2016	857	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	BKG	WELL 2	WELL 3
ALUMINUM	.003	.020	10.000
BARIUM	.001	.050	.250
CALCIUM	50.000	50.000	10.000
IRON	.010	5.000	5.000
MAGNESIUM	1.000	1.500	1.500
MANGANESE	.010	3.000	.200
POTASSIUM	.200	.200	2.000
SILICA	3.000	1.000	50.000
SODIUM	15.000	3.000	3.000
STRONTIUM	1.000	1.000	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.003	.001	.001
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.010	.001	.020
COBALT	.002	.010	.005
COPPER	.003	.003	.005
LEAD	.002	<.001	.003

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP. S-1 , NH

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	BKG	WELL 2	WELL 3	
MOLYBDENUM	.003	<.001	<.001	
NICKEL	.003	.005	.005	
SILVER	.002	.020	.002	
TIN	<.001	.002	.001	
TITANIUM	<.001	<.001	2.000	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<.001	<.001	.010	
ZINC	<.001	<.001	<.001	
ZIRCONIUM	<.002	<.002	.003	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	BKG	WELL 2	WELL 3	
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	.00	<.01	
COPPER	<.01	<.01	<.01	
IRON, TOTAL	.03	280.00	.22	
MANGANESE	<.01	59.00	.32	
NICKEL	<.03	.30	.00	
LEAD	.00	.00	.00	
ZINC	.00	.00	.00	
BARIUM	.00	.20	<.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.00	.00	
MOLYBDENUM	<.03	.00	.00	
TIN	.00	<1.00	.00	
VANADIUM	.00	.00	<.08	

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP. S-1 , NH

SAMPLE NO.	BKG	WELL 2	WELL 3	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0500	.1200	.0900	
CYANIDE	.0010	.0050	<.0050	
PHENOLS	.0020	.3200	.0050	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	.1200	<.0300	
CHROMIUM+6	<.0100	<.0100	.0000	
SELENIUM	<.0100	.0300	.2500	
SULFATE	11.000	4.200	.000	
CALCIUM	33.000	190.000	.000	
MAGNESIUM	3.400	36.000	.000	
CHLORIDE	83.000	32.000	.000	
PHOSPHATE	.040	.010	.000	
POTASSIUM	2.000	14.000	.000	
SODIUM	37.000	87.000	.000	

ANALYSIS OF WATER SAMPLES FROM
NEW HAMP, S-1 , NH

SAMPLE BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

BACKGROUND WELL

TOTAL WELL DEPTH: 25 FT

DISTANCE FROM DISPOSAL AREA: 1500 FT

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP, S-1 , NH

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001,TOTAL .001-.002

PESTICIDES
<.001

VOLATILES
HVY ORG:APX .25 PHENOLS,OTHERS <.01,LT V:6.2 4.7 3.4 1.0

REMARKS

HEAVY LEACHATE ODOR

SAMPLE CLEAR,GREENISH TINT

MONITOR WELL 2, LEACHATE

TOTAL WELL DEPTH: 40 FT

DISTANCE FROM DISPOSAL AREA: 200 FT

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP. S-1 , NH

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES: 28

REMARKS

SLIGHT LEACHATE ODOR

SAMPLE SLIGHTLY TURBID

MONITOR WELL 3,LEACHATE

TOTAL WELL DEPTH: 16 FT

DISTANCE FROM DISPOSAL AREA: 250 FT

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP, S-2 , NH

SAMPLE NO.	WELL 3 BKG	WELL 1	WELL 2	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/9/76	11/9/76	11/9/76	
TIME	12:30	13:30	11:00	
TEMPERATURE	8.0	7.0	10.0	
PH	6.1	5.5	5.6	
SPECIFIC CONDUCTANCE	174	590	1856	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.020	8.000	2.000
BARIUM	.050	.250	.100
CALCIUM	50.000	10.000	3.000
IRON	.010	5.000	5.000
MAGNESIUM	2.000	1.500	5.000
MANGANESE	.100	.200	.100
POTASSIUM	.500	3.000	.500
SILICA	3.000	50.000	50.000
SODIUM	5.000	5.000	1.000
STRONTIUM	1.000	1.000	.050
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.005	<.001	.001
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.020	.002
COBALT	<.001	.003	<.001
COPPER	.030	.001	.003
LEAD	.001	<.001	.001

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP. S-2 , NH

SAMPLE NO.	WELL 3 BKG	WELL 1	WELL 2	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<.001	<.001	<.001	
NICKEL	.002	.003	<.001	
SILVER	.005	.010	.002	
TIN	<.001	.003	<.001	
TITANIUM	.001	2.000	.200	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<.001	.010	<.001	
ZINC	.005	<.001	<.001	
ZIRCONIUM	<.002	.005	<.002	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	<.01	
COPPER	.04	.01	<.01	
IRON, TOTAL	.00	27.00	250.00	
MANGANESE	.01	.70	1.80	
NICKEL	<.03	.00	.00	
LEAD	<.10	.00	<.10	
ZINC	.00	.00	.00	
BARIUM	<.10	.10	.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.00	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	<.08	.00	

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP, S-2 , NH

SAMPLE NO.	WELL 3 BKG	WELL 1	WELL 2	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0500	.0600	.0400	
CYANIDE	<.0050	<.0050	.0040	
PHENOLS	.0060	.0100	.3400	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	.0300	.0900	
SULFATE	10.000	2.500	12.000	
CALCIUM	14.000	30.000	77.000	
MAGNESIUM	2.600	6.900	14.000	
CHLORIDE	8.000	128.000	279.000	
PHOSPHATE	.040	.310	.140	
POTASSIUM	5.200	5.900	4.900	
SODIUM	6.800	47.000	65.000	

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP. S-2 , NH

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED TANNERY WASTE,PLASTICS,OTHER INDUSTRIAL

BACKGROUND WELL

TOTAL WELL DEPTH: 8 FT

DISTANCE FROM DISPOSAL AREA: 4000 FT

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP. S-2 , NH

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: 5.6

REMARKS

NEAR TANNERY WASTES

SAMPLE TURBID

MONITOR WELL 1, LEACHATE

TOTAL WELL DEPTH: 10 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW HAMP, S-2 , NH

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
,002 AS TOTAL PCB'S, OTHER ELECTRONEGATIVE COMPOUNDS PRESENT
<,001

PESTICIDES
<,001

VOLATILES
HVY O:APX ,25 PHENOLS,OTHERS<,01, LT V: 3,2 85 62 14 1,2 1,0
4,0 1,0

REMARKS

SITE ACCEPTED TANNERY WASTE,PLASTICS,OTHER INDUSTRIAL

SAMPLE TURBID

MONITOR WELL 2, LEACHATE AT INDUSTRIAL SLUDGE SITE

TOTAL WELL DEPTH: 6 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-1 , NJ

SAMPLE NO.	BORING 1	WELL 1 BKG	WELL 3	
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	7/26/76	8/6/76	10/28/76	
TIME			12:20	
TEMPERATURE	17,0			
PH	6,5			
SPECIFIC CONDUCTANCE	1300			
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	BORING 1	WELL 1 BKG	WELL 3
ALUMINUM	3,000	5,000	3,000
BARIUM	<,001	<,001	,001
CALCIUM	3,000	10,000	3,000
IRON	5,000	,300	5,000
MAGNESIUM	,100	,750	1,000
MANGANESE	,050	,010	,010
POTASSIUM	<,100	8,000	<,100
SILICA	50,000	5,000	50,000
SODIUM	,000	50,000	<,100
STRONTIUM	,002	,050	,005
ANTIMONY	<1,000	<1,000	<1,000
ARSENIC	<1,000	<1,000	<1,000
BERYLLIUM	<1,000	<1,000	<1,000
BISMUTH	<1,000	<1,000	<1,000
BORON	,005	,002	,005
CADMIUM	<1,000	<1,000	<1,000
CHROMIUM	,005	,001	,003
COBALT	,005	<,001	<,001
COPPER	,010	,001	,010
LEAD	,002	<,001	,002

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-1 , NJ

SAMPLE NO.	BORING 1	WELL 1 BKG	WELL 3	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	BORING 1	WELL 1 BKG	WELL 3	
MOLYBDENUM	<1.000	<.001	<1.000	
NICKEL	.005	.002	.005	
SILVER	<1.000	<.001	.001	
TIN	.002	<1.000	<1.000	
TITANIUM	.200	.003	.050	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<.001	<1.000	
ZINC	2.000	<.001	.150	
ZIRCONIUM	<1.000	<.002	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

	BORING 1	WELL 1 BKG	WELL 3	
CADMIUM	.00	<.01	.00	
CHROMIUM	.15	<.01	<.01	
COPPER	.81	<.01	.01	
IRON, TOTAL	480.00	.95	31.00	
MANGANESE	2.30	.05	.00	
NICKEL	.00	<.03	<.03	
LEAD	.00	<.10	<.10	
ZINC	240.00	.06	4.80	
BARIUM	.00	<.10	.00	
BERYLLIUM	.00	.00	.00	
COBALT	.04	<.01	.00	
MOLYBDENUM	.00	<.03	.00	
TIN	.00	<1.00	.00	
VANADIUM	.00	<.08	.00	

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-1 , NJ

SAMPLE NO.	BORING 1	WELL 1 BKG	WELL 3	
	----------	----------	----------	----------
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0700	.1200	<.0200	
CYANIDE	.0000	<.0050	<.0050	
PHENOLS	.0000	.0080	.0080	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	.0000	.0400	.0200	
SULFATE	.000	99.000	12.000	
CALCIUM	.000	9.000	5.000	
MAGNESIUM	.000	8.000	.900	
CHLORIDE	.000	12.000	3.100	
PHOSPHATE	.000	<.003	.020	
POTASSIUM	.000	30.000	1.000	
SODIUM	.000	68.000	1.300	

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-1 , NJ

SAMPLE BORING 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECNGTV CMPDS PRESENT .001-.003,MAYBE PBB OR ALKYLATED CHLOROBIPHENYL

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SITE ACCEPTED LIQUID CHEMICAL WASTE

WATER STANDING IN CASING,POSSIBLE CAUSE OF HIGH ZN & FE

ZN INTERFERENCE ON NA2O ANALYSIS,INTERFERENCE ON SE ALSO

TOTAL WELL DEPTH: 48 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-1 , NJ

SAMPLE WELL 1 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

BACKGROUND WELL

TOTAL WELL DEPTH: 80 FT

DISTANCE FROM DISPOSAL AREA: 950 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-1 , NJ

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: 45 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-2 , NJ

SAMPLE NO.	WELL 2 BKG	WELL 1		
DISPOSAL TYPE	LANDFILL	LANDFILL		
WATER TYPE	GROUND	GROUND		
DATE SAMPLED	8/5/76	8/5/76		
TIME				
TEMPERATURE	17.8	15.6		
PH	5.8	7.2		
SPECIFIC CONDUCTANCE	430	290		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	5.000	5.000
BARIUM	.100	.010
CALCIUM	50.000	50.000
IRON	.500	.300
MAGNESIUM	3.000	10.000
MANGANESE	.100	.100
POTASSIUM	.100	2.000
SILICA	15.000	10.000
SODIUM	2.500	8.000
STRONTIUM	1.000	1.000
ANTIMONY	<1.000	<1.000
ARSENIC	<1.000	<1.000
BERYLLIUM	<1.000	<1.000
BISMUTH	<1.000	<1.000
BORON	.003	.005
CADMIUM	<1.000	<1.000
CHROMIUM	.010	.010
COBALT	<.001	.001
COPPER	.010	.010
LEAD	.003	.001

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-2 , NJ

SAMPLE NO.	WELL 2BKG	WELL 1		

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	WELL 2BKG	WELL 1
MOLYBDENUM	,001	,001
NICKEL	,005	,020
SILVER	<,001	<,001
TIN	<1,000	<1,000
TITANIUM	,100	,050
TUNGSTEN	<1,000	<1,000
VANADIUM	<,001	<,001
ZINC	<,001	,002
ZIRCONIUM	<,002	<,002
GERMANIUM	<1,000	<1.000
TELLURIUM	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

	WELL 2BKG	WELL 1
CADMIUM	<,01	<,01
CHROMIUM	<,01	<.01
COPPER	<,01	,01
IRON, TOTAL	.00	,40
MANGANESE	.11	,29
NICKEL	<,03	.20
LEAD	<,10	<,10
ZINC	,03	.06
BARIUM	.01	.10
BERYLLIUM	.00	,00
COBALT	<,01	<,01
MOLYBDENUM	<,03	<,03
TIN	<1,00	<1,00
VANADIUM	<,08	<,08

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-2 , NJ

SAMPLE NO.	WELL 2 BKG	WELL 1		
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.3300	.3800		
CYANIDE	<.0050	.0000		
PHENOLS	<.0010	.0100		
MERCURY	<.0005	<.0005		
ARSENIC	<.0300	<.0300		
CHROMIUM+6	<.0100	<.0100		
SELENIUM	.2200	.0200		
SULFATE	29.000	22.000		
CALCIUM	68.000	65.000		
MAGNESIUM	17.000	10.000		
CHLORIDE	22.000	48.000		
PHOSPHATE	.390	<.003		
POTASSIUM	14.000	11.000		
SODIUM	12.000	15.000		

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-2 , NJ

SAMPLE WELL 2 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SAMPLE TURBID

TOTAL WELL DEPTH: 60 FT

DISTANCE FROM DISPOSAL AREA: 400 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-2 , NJ

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: 79 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-3 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4
DISPOSAL TYPE	COMBINATION	COMBINATION	COMBINATION	COMBINATION
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	6/21/76	6/21/76	6/22/76	6/22/76
TIME	13:45	16:25	10:40	12:45
PH	7.2	7.1	7.7	7.2
TDS,MG/L	10,360	13,570	4,830	9,860
HARDNESS CACO3,MG/L	1,540	2,150	1,570	1,730

EMISSION SPECTROSCOPY RESULTS OF ELEMENTS REPORTED IN MG/L

ALUMINUM	34	79	29	53
BARIUM	<14	<15	<79	<14
CALCIUM	110	480	110	87
IRON	11	240	160	<4.5
MAGNESIUM	170	290	110	180
MANGANESE	4.5	8.5	3.7	<1.4
SILICON	11	91	32	96
SODIUM	1,600	470	520	180
STRONTIUM	<14	<15	<7.9	<14
ANTIMONY	<4.7	<5.1	<2.6	<4.5
ARSENIC	<47	<51	<26	<45
BERYLLIUM	<4.7	<5.1	<2.6	<4.5
BORON	<4.7	<5.1	<2.6	<4.5
CADMIUM	<4.7	<5.1	<2.6	<4.5
CHROMIUM	<1.4	<1.5	<0.79	<1.4

EMISSION SPECTROSCOPY RESULTS OF ELEMENTS REPORTED IN MG/L (CONT.)

COBALT	<1.4	<1.5	<0.79	<1.4
COPPER	<1.4	<1.5	<0.79	<1.4
LEAD	<4.7	12	19	<4.5
MOLYBDENUM	<1.4	<1.5	<0.79	<1.4
NICKEL	<4.7	<5.1	<2.6	<4.5
SILVER	<1.4	<1.5	<0.79	<1.4
TIN	<1.4	<1.5	<0.79	<1.4
TITANIUM	<1.4	<1.5	<0.79	<1.4
VANADIUM	<1.4	<1.5	<0.79	<1.4
ZINC	<14	<15	<7.9	<14
ZIRCONIUM	<1.4	<1.5	<0.79	<1.4

OTHER CONSTITUENTS, MG/L

AMMONIA-N	7.9	30.4	74.4	8.28
NITRATE-N	0.34	0.15	0.31	0.07
ORGANIC-N	1.4	14.9	23.4	0.35
SULFATE	240	420	65.8	420
CHLORIDE	4,270	4,670	1,740	4,670
PHENOL	0.136	0.034	0.138	0.026
CYANIDE	0.05	<0.02	<0.02	--
ALKALINITY	670	1,120	2,050	840

ORGANIC COMPOUNDS, DETECTED (+) AND NOT DETECTED (-)

TOLUENE	+	+	+	-
XYLENES	+	+	+	+
ALKYL BENZENES	+	-	+	-
C4 ALCOHOL	-	-	+	-
METHYL ETHYL KETONE	-	-	+	-
CAMPHOR	-	-	+	-
NAPHTHALENE	-	-	+	-
BENZENE	+	-	+	-

ANALYSIS OF WATER SAMPLES FROM
NEW JERSEY S-3, NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3	WELL 4
TOTAL WELL DEPTH, FT	40	26	24	28
DISTANCE TO DISPOSAL AREA, FT	180	380	215	300

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-3 , NJ

SAMPLE NO.	WELL 5	WELL 6 BKG	WELL 8	RIVER
DISPOSAL TYPE	COMBINATION	COMBINATION	COMBINATION	-
WATER TYPE	GROUND	GROUND	GROUND	SURFACE
DATE SAMPLED	6/23/76	6/23/76	6/23/76	6/23/76
TIME	11:30	09:50	14:00	10:45
PH	5.9	4.7	7.2	7.3
TDS, MG/L	210	140	7,580	4,320
HARDNESS CACO3,MG/L	78.3	34.7	36.7	430

EMISSION SPECTROSCOPY RESULTS OF ELEMENTS REPORTED IN MG/L

ALUMINUM	42	0.78	24	0.13
BARIUM	<14	<1.9	<10	150
CALCIUM	120	2	44	11
IRON	22	4.4	63	10
MAGNESIUM	180	<0.19	110	9
MANGANESE	<4.2	<0.47	1.6	<8.5
SILICON	<14	<1.9	<10	25
SODIUM	1,700	<2	960	2,000
STRONTIUM	<14	<1.9	<10	25
ANTIMONY	<4.5	<0.66	<3.4	8.5
ARSENIC	<45	<6.6	<34	<12
BERYLLIUM	<4.5	<0.66	<3.4	10
BORON	<4.5	<0.66	<3.4	14
CADMIUM	<4.5	<0.66	<3.4	4.8
CHROMIUM				

EMISSION SPECTROSCOPY RESULTS OF ELEMENTS REPORTED IN MG/L (CONT.)

COBALT	<1.4	<0.19	<1.0	0.84
COPPER	<1.4	0.31	<1.0	2.8
LEAD	<4.5	<0.66	<3.4	<1.2
MOLYBDENUM	<1.4	<0.19	<1.0	3.4
NICKEL	<4.5	<0.66	3.4	10
SILVER	<1.4	<0.19	<1.0	<0.35
TIN	<1.4	<0.19	<1.0	1.2
TITANIUM	<1.4	<0.19	<1.0	11
VANADIUM	<1.4	<0.19	<1.0	11
ZINC	<14	<1.9	<10	14
ZIRCONIUM	<1.4	<0.19	<1.0	<0.35

OTHER CONSTITUENTS, MG/L

AMMONIA-N	0.56	0.39	7.10	2.26
NITRATE-N	2.43	1.18	0.68	2.28
ORGANIC-N	5.39	0.19	8.16	0.08
SULFATE	110	36.2	200	1,960
CHLORIDE	60.5	120	3,650	940
PHENOL	--	--	0.001	0.002
CYANIDE	--	--	<0.02	--
ALKALINITY	15.7	1.61	67	58.7

ORGANIC COMPOUNDS, DETECTED (+), AND NOT DETECTED (-)

TOLUENE	-	-	-	-
XYLENES	+	-	-	-
ALKYL BENZENES	-	-	-	-
C4 ALCOHOL	-	-	-	-
METHYL ETHYL KETONE	+	-	-	-
CAMPHOR	-	-	-	-
NAPHTHALENE	-	-	-	-
BENZENE	-	-	-	-

ANALYSIS OF WATER SAMPLES FROM
NEW JERSEY S-3, NJ

SAMPLE NO.	WELL 5	WELL 6	WELL 8	RIVER
TOTAL WELL DEPTH, FT	18	14	17	NOT APPLICABLE
DISTANCE TO DISPOSAL AREA, FT	90	450	1500	NOT APPLICABLE

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

SAMPLE NO.	WELL 1	WELL 3 BKG	POWDER	WELL 2
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	SOIL	GROUND
DATE SAMPLED	8/4/76	8/4/76	8/4/76	8/4/76
TIME				
TEMPERATURE	12,8	14,4		
PH	4,6	4,5		
SPECIFIC CONDUCTANCE	.220	60		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	8,000	8,000	,000	,000
BARIUM	,750	.250	,000	,000
CALCIUM	50,000	10,000	,000	,000
IRON	2,000	2,000	,000	,000
MAGNESIUM	10,000	5,000	,000	,000
MANGANESE	,250	,500	,000	,000
POTASSIUM	1,000	2,000	,000	,000
SILICA	25,000	50,000	,000	,000
SODIUM	15,000	10,000	,000	,000
STRONTIUM	,250	,050	,000	,000
ANTIMONY	<1,000	<1,000	,000	,000
ARSENIC	<1,000	<1,000	,000	,000
BERYLLIUM	<1,000	<1,000	,000	,000
BISMUTH	<1,000	<1,000	,000	,000
BORON	,050	,050	,000	,000
CADMIUM	<1,000	<1,000	,000	,000
CHROMIUM	.030	.050	,000	,000
COBALT	.010	.050	,000	,000
COPPER	,050	.500	,000	,000
LEAD	,002	,050	,000	,000

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

SAMPLE NO.	WELL 1	WELL 3 BKG	POWDER	WELL 2
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<.001	.001	.000	.000
NICKEL	.100	.250	.000	.000
SILVER	.001	.001	.000	.000
TIN	<1.000	<1.000	.000	.000
TITANIUM	.250	.250	.000	.000
TUNGSTEN	<1.000	<1.000	.000	.000
VANADIUM	.003	.001	.000	.000
ZINC	.002	.200	.000	.000
ZIRCONIUM	.005	.002	.000	.000
GERMANIUM	<1.000	<1.000	.000	.000
TELLURIUM	<1.000	<1.000	.000	.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	<.01	<.01	.00	.00
CHROMIUM	<.01	<.01	.00	420.00
COPPER	.01	.04	.00	.00
IRON, TOTAL	1.30	.89	>200.00	.00
MANGANESE	.09	.14	.00	.00
NICKEL	.07	<.03	.00	.00
LEAD	<.10	<.10	.00	.00
ZINC	.05	.69	.00	.00
BARIUM	<.10	.10	.00	.00
BERYLLIUM	.00	.00	.00	.00
COBALT	<.01	<.01	.00	.00
MOLYBDENUM	<.03	<.03	.00	.00
TIN	<1.00	<1.00	.00	.00
VANADIUM	<.08	<.08	.00	.00

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 3 BKG	POWDER	WELL 2
FLUORIDE	.0900	.1800	.0000	.0000
CYANIDE	<.0050	<.0050	.0000	.0000
PHENOLS	.0200	.0200	.0000	.0000
MERCURY	<.0005	<.0005	.0000	.0000
ARSENIC	<.0300	<.0300	.0000	.0000
CHROMIUM+6	<.0100	<.0100	.0000	.0000
SELENIUM	.2400	.1000	.0000	.0000
SULFATE	<1.000	9.500	10000.000	.000
CALCIUM	12.000	1.800	3900.000	.000
MAGNESIUM	3.500	2.500	.000	.000
CHLORIDE	49.000	7.000	19500.000	.000
PHOSPHATE	<.003	<.003	.000	.000
POTASSIUM	1.300	.680	220.000	.000
SODIUM	18.000	1.900	5600.000	.000

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

INDUSTRIAL LIQUID WASTE DISPOSAL

SAMPLE FAIRLY CLEAR

TOTAL WELL DEPTH: 53 FT

DISTANCE FROM DISPOSAL AREA: 120 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

INDUSTRIAL LIQUID WASTE DISPOSAL

SAMPLE CLEAR

TOTAL WELL DEPTH: 19 FT

DISTANCE FROM DISPOSAL AREA: 850 FT

BACKGROUND WELL

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

SAMPLE POWDER

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES

REMARKS

LAGOON WATER CONTAINS 1200 MG/L CR

SAMPLE OF WHITE POWDER

INTERFERENCE ON SE ANALYSIS,RESULTS ARE SOLUBLE VALUES

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 0 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-4 , NJ

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
.001, PCB RELATED COMPOUND

PESTICIDES
<.001

VOLATILES
4 ORGANIC SOLVENTS PRESENT, APX 200 MG/L TOTAL

REMARKS

CHEMICAL ODOR

SAMPLE TURBID, BRIGHT YELLOW

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-5 , NJ

SAMPLE NO.	WELL 1-D	WELL 1-S	WELL 2 BKG	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	8/2/76	8/2/76	8/2/76	
TIME				
TEMPERATURE	13.3	15.6	13.3	
PH	7.5	7.2	7.6	
SPECIFIC CONDUCTANCE	100	210	110	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	1.000	.500	1.000
BARIUM	.020	.150	.020
CALCIUM	15.000	50.000	10.000
IRON	1.000	2.000	1.000
MAGNESIUM	1.000	2.500	1.000
MANGANESE	.050	.100	.030
POTASSIUM	1.000	5.000	1.000
SILICA	50.000	5.000	50.000
SODIUM	2.000	10.000	3.000
STRONTIUM	.200	1.000	.100
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.010	<.001	.003
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.001	.005
COBALT	<.001	<.001	.001
COPPER	.003	.001	.005
LEAD	<1.000	<1.000	<1.000

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-5 , NJ

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	WELL 1-D	WELL 1-S	WELL 2 BKG
MOLYBDENUM	<1.000	<1,000	<1.000
NICKEL	,002	.001	.003
SILVER	<1,000	<1,000	<1,000
TIN	<1,000	<1.000	<1,000
TITANIUM	.010	.001	.002
TUNGSTEN	<1,000	<1,000	<1,000
VANADIUM	<.001	<,001	.001
ZINC	.001	<.001	,003
ZIRCONIUM	<1,000	<1.000	<1,000
GERMANIUM	<1.000	<1,000	<1,000
TELLURIUM	<1,000	<1,000	<1,000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	<,01	<,01	<,01
CHROMIUM	<,01	<.01	,01
COPPER	<,01	,05	,06
IRON, TOTAL	1,70	,50	,16
MANGANESE	,01	,15	,05
NICKEL	<,03	<,03	<,03
LEAD	<,10	<,10	<,10
ZINC	,02	,06	,54
BARIUM	<,10	<,10	<,10
BERYLLIUM	,00	,00	,00
COBALT	<,01	<,01	<,01
MOLYBDENUM	<,03	<,03	<,03
TIN	<1,00	<1,00	<1,00
VANADIUM	<,08	<,08	<,08

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-5 , NJ

SAMPLE NO.	WELL 1-D	WELL 1-S	WELL 2 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.3200	.3300	.0700	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0400	.0030	.0020	
MERCURY	.0060	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	.0200	.0200	.0500	
SULFATE	5.600	38.000	<1.000	
CALCIUM	17.000	64.000	6.400	
MAGNESIUM	6.000	4.500	8.000	
CHLORIDE	6.000	6.000	22.000	
PHOSPHATE	.080	.050	<.003	
POTASSIUM	3.000	5.500	6.500	
SODIUM	2.300	8.300	5.000	

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-5 , NJ

SAMPLE WELL 1-D

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SITE ACCEPTED MIXED INDUSTRIAL & MUNICIPAL WASTE

SAMPLE CLEAR

TOTAL WELL DEPTH: 55 FT

DISTANCE FROM DISPOSAL AREA: 1150 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-5 , NJ

SAMPLE WELL 1-S

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001 SEE REMARKS

PESTICIDES
<.001 SEE REMARKS

VOLATILES
<.01

REMARKS

SITE ACCEPTED MIXED INDUSTRIAL & MUNICIPAL WASTE

SAMPLE CLEAR

2 ELECTRONEGATIVE COMPOUNDS PRESENT,NOT PESTICIDE OR PCB,APP
X .001 & .004

TOTAL WELL DEPTH: 12 FT

DISTANCE FROM DISPOSAL AREA: 1150 FT

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-5 , NJ

SAMPLE WELL 2 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SITE ACCEPTED MIXED INDUSTRIAL & MUNICIPAL WASTE

SAMPLE TURBID

BACKGROUND WELL

TOTAL WELL DEPTH: 45 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-6 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	8/3/76	8/2/76	8/3/76	
TIME				
TEMPERATURE	14.4	17.2	14.4	
PH	7.9	6.6	4.5	
SPECIFIC CONDUCTANCE	180	2000	145	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 2	WELL 3 BKG
ALUMINUM	2.000	2.000	5.000
BARIUM	.001	.002	1.000
CALCIUM	3.000	5.000	20.000
IRON	.250	2.500	2.000
MAGNESIUM	.200	.750	15.000
MANGANESE	.003	.050	.500
POTASSIUM	<.100	.250	5.000
SILICA	15.000	50.000	50.000
SODIUM	.200	1.000	15.000
STRONTIUM	.003	.050	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.002	.005	.030
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.005	.005	.050
COBALT	<.001	<.001	.005
COPPER	.002	.003	.050
LEAD	<.001	<1.000	.003

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-6 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	WELL 1	WELL 2	WELL 3 BKG	
MOLYBDENUM	<.001	<1.000	.002	
NICKEL	.001	.003	.030	
SILVER	<.001	<1.000	.001	
TIN	<1.000	<1.000	<1.000	
TITANIUM	.250	.050	.200	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	.001	.003	.002	
ZINC	<.001	<.001	.050	
ZIRCONIUM	.002	<1.000	<.002	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

	WELL 1	WELL 2	WELL 3 BKG	
CADMIUM	<.01	<.01	<.01	
CHROMIUM	<.01	<.01	<.01	
COPPER	<.01	<.01	<.01	
IRON, TOTAL	.21	100.00	1.20	
MANGANESE	.01	1.00	.09	
NICKEL	<.03	<.03	<.03	
LEAD	<.10	<.10	<.10	
ZINC	.36	.40	.13	
BARIUM	<.10	.60	.10	
BERYLLIUM	.00	.00	.00	
COBALT	<.01	<.01	<.01	
MOLYBDENUM	<.03	<.03	<.03	
TIN	<1.00	<1.00	<1.00	
VANADIUM	<.08	<.08	<.08	

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-6 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3 BKG	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	1,3000	.1400	.1000	
CYANIDE	<,0050	<,0050	.0050	
PHENOLS	,0080	,0300	.0300	
MERCURY	<,0005	<.0005	<,0005	
ARSENIC	<,0300	<,0300	<,0300	
CHROMIUM+6	.0000	<,0100	<,0100	
SELENIUM	,0200	.0100	<,0100	
SULFATE	25,000	1.200	7.700	
CALCIUM	280,000	180,000	6,400	
MAGNESIUM	250,000	25.000	15,000	
CHLORIDE	40,000	440,000	20.000	
PHOSPHATE	.000	,040	<,003	
POTASSIUM	4.900	30,000	3,800	
SODIUM	13.000	130,000	3.800	

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-6 , NJ

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SOLID AND LIQUID INDUSTRIAL WASTES

SAMPLE TURBID

TOTAL WELL DEPTH: 40 FT

DISTANCE FROM DISPOSAL AREA: 600 FT

(391)

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-6 , NJ

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
TRACE QUANTITIES ELECTRONEGATIVE COMPOUNDS PRESENT <.001

VOLATILES
2 ORGANICS PRESENT: 1.2 & 2.9

REMARKS

CHEMICAL ODOR

SITE ACCEPTED LIQUID & SOLID INDUSTRIAL WASTES

SAMPLE DISCOLORED

TOTAL WELL DEPTH: 4 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-6 , NJ

SAMPLE WELL 3 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
<.01

REMARKS

SITE ACCEPTED SOLID & LIQUID INDUSTRIAL WASTES

SAMPLE TURBID

BACKGROUND WELL

TOTAL WELL DEPTH: 25 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-7 , NJ

SAMPLE NO.	BKG	WELL 1	WELL 2	WELL 3
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	10/28/76	10/28/76	10/28/76	10/28/76
TIME	13:45	14:50	14:30	15:10
TEMPERATURE				
PH				
SPECIFIC CONDUCTANCE				
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.200	.100	3.000	.030
BARIUM	.250	.100	.001	.100
CALCIUM	50.000	50.000	20.000	50.000
IRON	5.000	.100	.010	.250
MAGNESIUM	20.000	8.000	2.000	10.000
MANGANESE	1.000	.010	.050	.010
POTASSIUM	.200	.250	.250	.100
SILICA	10.000	5.000	50.000	5.000
SODIUM	5.000	5.000	5.000	10.000
STRONTIUM	.500	.500	.100	.050
ANTIMONY	<1.000	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.030	.005	.005	.003
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.010	.002	.003	.010
COBALT	.003	.010	.002	.002
COPPER	.010	.010	.010	.010
LEAD	<.001	.001	.001	.005

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-7 , NJ

SAMPLE NO.	BKG	WELL 1	WELL 2	WELL 3

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000	<1.000	<1.000	<1.000
NICKEL	.005	.003	.002	.003
SILVER	.003	.001	.003	.002
TIN	<1.000	<1.000	<1.000	.002
TITANIUM	.003	.001	.010	.001
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000	<1.000
ZINC	.005	.010	.010	.010
ZIRCONIUM	<1.000	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	<.01	<.01
COPPER	.03	.01	<.01	<.01
IRON, TOTAL	7.70	.18	.00	.13
MANGANESE	.02	.00	.11	.00
NICKEL	<.03	<.03	<.03	<.03
LEAD	.00	.00	.00	<.10
ZINC	.00	.00	1.20	.00
BARIUM	<.10	<.10	.00	<.10
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	<.01	<.01	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-7 , NJ

SAMPLE NO.	BKG	WELL 1	WELL 2	WELL 3
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0000	<.0200	.0600	.0800
CYANIDE	<.0050	<.0050	<.0050	<.0050
PHENOLS	.0200	.0300	.0080	.0030
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	.0100	<.0100	<.0100	<.0100
SULFATE	.000	15.000	60.000	1.700
CALCIUM	2.700	13.000	20.000	6.100
MAGNESIUM	.500	1.900	5.300	5.000
CHLORIDE	.000	10.000	48.000	10.000
PHOSPHATE	.000	.020	.009	.030
POTASSIUM	.380	.790	5.000	.880
SODIUM	9.600	6.700	35.000	13.000

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-7 , NJ

SAMPLE BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

BACKGROUND WELL

HIGH FE POSSIBLY FROM PLUMBING

TOTAL WELL DEPTH: UNKNOWN (WATER-TABLE WELL)

DISTANCE FROM DISPOSAL AREA: APPROXIMATELY 10,500 FT.

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-7 , NJ

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: APPROXIMATELY 25 FT.

DISTANCE FROM DISPOSAL AREA: APPROXIMATELY 500 FT.

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-7 , NJ

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
HEAVY ORGANICS: <,01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: APPROXIMATELY 25 FT.

DISTANCE FROM DISPOSAL AREA: APPROXIMATELY 700 FT.

399

ANALYSIS OF WATER SAMPLES FROM
NEW JERSEY S-7 , NJ

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: APPROXIMATELY 25 FT

DISTANCE FROM DISPOSAL AREA: APPROXIMATELY 600 FT.

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-8 , NJ

SAMPLE NO.	WELL 8	WELL 1 BKG		
DISPOSAL TYPE	LANDFILL	LANDFILL		
WATER TYPE	GROUND	GROUND		
DATE SAMPLED	12/21/76	12/21/76		
TIME	13:30	15:00		
TEMPERATURE	13.5	13.0		
PH	6.8	6.5		
SPECIFIC CONDUCTANCE	3500	89		
DISSOLVED OXYGEN	.02	.03		

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.010	5.000
BARIUM	.001	.010
CALCIUM	50.000	50.000
IRON	1.000	2.000
MAGNESIUM	8.000	8.000
MANGANESE	.100	.100
POTASSIUM	.250	.150
SILICA	.030	15.000
SODIUM	10.000	5.000
STRONTIUM	.050	.150
ANTIMONY	<1.000	<1.000
ARSENIC	<1.000	<1.000
BERYLLIUM	<1.000	<1.000
BISMUTH	<1.000	<1.000
BORON	.010	.030
CADMIUM	<1.000	<1.000
CHROMIUM	.001	.020
COBALT	.003	<.001
COPPER	.001	.003
LEAD	<1.000	<1.000

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-8 , NJ

SAMPLE NO.	WELL 8	WELL 1BKG		

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	WELL 8	WELL 1BKG
MOLYBDENUM	<1.000	<1,000
NICKEL	<,001	,010
SILVER	,001	,002
TIN	<1,000	<1,000
TITANIUM	<,001	,050
TUNGSTEN	<1,000	<1,000
VANADIUM	<1.000	<1,000
ZINC	<,001	,003
ZIRCONIUM	<1,000	<1,000
GERMANIUM	<1.000	<1.000
TELLURIUM	<1,000	<1,000

QUANTITATIVE METALS RESULTS, MG/L

	WELL 8	WELL 1BKG
CADMIUM	,00	.00
CHROMIUM	,01	<,01
COPPER	,01	<,01
IRON, TOTAL	68,00	.81
MANGANESE	4.70	,12
NICKEL	,00	<,03
LEAD	,00	.00
ZINC	,00	,00
BARIUM	,20	<,10
BERYLLIUM	,00	,00
COBALT	.04	.00
MOLYBDENUM	,00	,00
TIN	,00	.00
VANADIUM	,00	,00

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-8 , NJ

SAMPLE NO.	WELL 8	WELL 1 BKG		
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.1800	.1200		
CYANIDE	<.0050	<.0050		
PHENOLS	.0070	.0100		
MERCURY	<.0005	<.0005		
ARSENIC	<.0300	<.0300		
CHROMIUM+6	<.0100	<.0100		
SELENIUM	.0100	<.0100		
SULFATE	1660.000	12.000		
CALCIUM	310.000	19.000		
MAGNESIUM	390.000	2.900		
CHLORIDE	111.000	6.000		
PHOSPHATE	.070	.050		
POTASSIUM	420.000	1.100		
SODIUM	550.000	3.100		

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-8 , NJ

SAMPLE WELL 8

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
HU:.01 .12 .01 .01 .25 .08 .11,LV:310 19 13 1.5 2.4 1.8 2.9
.5 .8 .8 2.2 32

REMARKS

VERY STRONG VOLATILE (KETONE) ODOR FROM LEACHATE SAMPLE

SITE ACCEPTED INDUSTRIAL WASTE

SAMPLE DEEP REDDISH-BROWN COLOR,BUT NOT TURBID

INDUSTRIAL MONITORING WELL, LEACHATE

TOTAL WELL DEPTH: 47 FT

DISTANCE FROM DISPOSAL AREA: 450 FT

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-8 , NJ

SAMPLE WELL 1 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: ONE PEAK APPX .01,LIGHT VOLATILES:<1

REMARKS

VERY LITTLE ODOR

SITE ACCEPTED INDUSTRIAL WASTE

SAMPLE LT. TAN COLOR,VERY LITTLE TURBIDITY

INDUSTRIAL MONITORING WELL, BACKGROUND

TOTAL WELL DEPTH: 60 FT

DISTANCE FROM DISPOSAL AREA: 250 FT

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-9 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3	BKG
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	LAGOON
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	2/77	2/77	2/77	2/77
TIME				
TEMPERATURE				
PH	4.3	5.4	3.8	7.1
SPECIFIC CONDUCTANCE	2000	800	1100	300
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.000	.000	.000	.000
BARIUM	.000	.000	.000	.000
CALCIUM	.000	.000	.000	.000
IRON	.000	.000	.000	.000
MAGNESIUM	.000	.000	.000	.000
MANGANESE	.000	.000	.000	.000
POTASSIUM	.000	.000	.000	.000
SILICA	.000	.000	.000	.000
SODIUM	.000	.000	.000	.000
STRONTIUM	.000	.000	.000	.000
ANTIMONY	.000	.000	.000	.000
ARSENIC	.000	.000	.000	.000
BERYLLIUM	.000	.000	.000	.000
BISMUTH	.000	.000	.000	.000
BORON	.000	.000	.000	.000
CADMIUM	.000	.000	.000	.000
CHROMIUM	.000	.000	.000	.000
COBALT	.000	.000	.000	.000
COPPER	.000	.000	.000	.000
LEAD	.000	.000	.000	.000

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-9 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3	BKG

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	.000	.000	.000	.000
NICKEL	.000	.000	.000	.000
SILVER	.000	.000	.000	.000
TIN	.000	.000	.000	.000
TITANIUM	.000	.000	.000	.000
TUNGSTEN	.000	.000	.000	.000
VANADIUM	.000	.000	.000	.000
ZINC	.000	.000	.000	.000
ZIRCONIUM	.000	.000	.000	.000
GERMANIUM	.000	.000	.000	.000
TELLURIUM	.000	.000	.000	.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00	.00
CHROMIUM	.01	<.01	<.01	<.01
COPPER	.04	<.01	.17	<.01
IRON, TOTAL	38.00	17.00	19.00	1.90
MANGANESE	.00	.00	.00	.00
NICKEL	.07	<.03	<.03	<.03
LEAD	.00	.00	.00	.00
ZINC	.40	.38	.59	.04
BARIUM	.00	.00	.00	.00
BERYLLIUM	.00	.00	.00	.00
COBALT	.22	.07	.05	<.01
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-9 , NJ

SAMPLE NO.	WELL 1	WELL 2	WELL 3	BKG
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.0000	.0000	.0000	.0000
CYANIDE	.0000	.0000	.0000	.0000
PHENOLS	.0600	.0300	.0300	.0500
MERCURY	.0000	.0000	.0000	.0000
ARSENIC	.0000	.0000	.0000	.0000
CHROMIUM+6	.0000	.0000	.0000	.0000
SELENIUM	.0000	.0000	.0000	.0000
SULFATE	620.000	160.000	230.000	30.000
CALCIUM	45.000	55.000	50.000	25.000
MAGNESIUM	19.000	13.000	13.000	3.900
CHLORIDE	116.000	107.000	203.000	27.000
PHOSPHATE	.050	.070	.070	.090
POTASSIUM	5.800	4.300	5.700	4.800
SODIUM	330.000	100.000	140.000	39.000

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-9 , NJ

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES
LIGHT VOLATILES: 0.3 TRICHLOROETHYLENE

REMARKS

SITE ACCEPTED PETROLEUM WASTE

PRODUCTION WELL

TOTAL WELL DEPTH: 156 FT.

DISTANCE FROM DISPOSAL AREA: 300 FT.

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ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-9 , NJ

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES
LIGHT VOLATILES:0.3 TRICHLOROETHYLENE

REMARKS

SITE ACCEPTED PETROLEUM WASTE

PRODUCTION WELL

TOTAL WELL DEPTH: 280 FT.

DISTANCE FROM DISPOSAL AREA: 100 FT.

4

ANALYSIS OF WATER SAMPLES FROM
NEW JERSEY S-9 , NJ

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES
LIGHT VOLATILES:0.2 TRICHLOROETHYLENE

REMARKS

SITE ACCEPTED PETROLEUM WASTE

PRODUCTION WELL

TOTAL WELL DEPTH: 267 FT.

DISTANCE FROM DISPOSAL AREA: 200 FT.

ANALYSIS OF WATER SAMPLES FROM

NEW JERSEY S-9 , NJ

SAMPLE BKG

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES

REMARKS

SITE: ACCEPTED PETROLEUM WASTE

BACKGROUND

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: UNKNOWN

4

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-1 , NY

SAMPLE NO.	BKG	SPRING	WELL 1	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	11/22/76	11/22/76	11/22/76	
TIME				
TEMPERATURE	13.8	10.6	10.0	
PH	6.7	6.6		
SPECIFIC CONDUCTANCE	175	222	200	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	1.000	1.000	.000
BARIUM	.001	.001	.000
CALCIUM	50.000	50.000	.000
IRON	.250	.200	.000
MAGNESIUM	5.000	8.000	.000
MANGANESE	.005	.010	.000
POTASSIUM	.250	.300	.000
SILICA	15.000	15.000	.000
SODIUM	8.000	8.000	.000
STRONTIUM	1.000	2.000	.000
ANTIMONY	<1.000	<1.000	.000
ARSENIC	<1.000	<1.000	.000
BERYLLIUM	<1.000	<1.000	.000
BISMUTH	<1.000	<1.000	.000
BORON	.010	.050	.000
CADMIUM	<1.000	<1.000	.000
CHROMIUM	.005	.010	.000
COBALT	<.001	.002	.000
COPPER	.010	.030	.000
LEAD	.001	.005	.000

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-1 , NY

SAMPLE NO.	HKG	SPRING	WELL 1	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	HKG	SPRING	WELL 1	
MOLYBDENUM	<1.000	<1,000	.000	
NICKEL	.005	.003	.000	
SILVER	.002	.001	.000	
TIN	<1,000	<1.000	.000	
TITANIUM	.010	.050	.000	
TUNGSTEN	<1.000	<1,000	.000	
VANADIUM	<1.000	<1,000	.000	
ZINC	.005	.003	.000	
ZIRCONIUM	<.002	<.002	.000	
GERMANIUM	<1,000	<1,000	.000	
TELLURIUM	<1.000	<1.000	.000	

QUANTITATIVE METALS RESULTS, MG/L

	HKG	SPRING	WELL 1	
CADMIUM	.00	.00	<.01	
CHROMIUM	<.01	<.01	.00	
COPPER	<.01	.10	<.01	
IRON, TOTAL	.11	.18	2.30	
MANGANESE	.00	.00	.00	
NICKEL	<.03	<.03	.00	
LEAD	<.10	<.10	<.10	
ZINC	.00	.00	.01	
BARIUM	<.10	.00	.00	
BERYLLIUM	.00	.00	.00	
COBALT	.00	<.01	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-1 , NY

SAMPLE NO.	BKG	SPRING	WELL 1	
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G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	.0800	.0900	.0000	
CYANIDE	<.0050	<.0050	.0000	
PHENOLS	.0500	.0050	.0000	
MERCURY	<.0005	<.0005	.0000	
ARSENIC	<.0300	<.0300	.0000	
CHROMIUM+6	<.0100	<.0100	.0000	
SELENIUM	<.0100	<.0100	.0000	
SULFATE	14.000	65.000	.000	
CALCIUM	20.000	65.000	.000	
MAGNESIUM	2.600	11.000	.000	
CHLORIDE	15.000	22.000	.000	
PHOSPHATE	.020	.050	.000	
POTASSIUM	1.500	5.400	.000	
SODIUM	1.500	4.600	.000	

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-1 , NY

SAMPLE BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED CAPACITORS , PCB'S

SAMPLE CLEAR

BACKGROUND WELL

TOTAL WELL DEPTH: 25 FT

DISTANCE FROM DISPOSAL AREA: 400 FT

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-1 , NY

SAMPLE SPRING

ORGANICS GROUP RESULTS, MG/L

PCBS
TOTAL .006 PCB'S, 8 PEAKS

PESTICIDES
CONTAINS HEPTACHLOR <.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED CAPACITORS, PCB'S

SAMPLE CLEAR

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 75 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-1 , NY

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES

VOLATILES

REMARKS

SITE ACCEPTED CAPACITORS,PCB'S

TOTAL WELL DEPTH: 52 FT

DISTANCE FROM DISPOSAL AREA: 400 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

SAMPLE NO.	SPRING BOX	RES.MON.W.	RES.W.BKG	MON.WELL 4
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	12/28/76	12/28/76	12/28/76	12/28/76
TIME	16:30	16:00	14:00	16:30
TEMPERATURE	66.0	66.0	13.1	20.0
PH	6.7	7.2	7.5	7.5
SPECIFIC CONDUCTANCE	144	205	190	514
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.010	.010	.005	.000
BARIUM	.001	.010	.003	.000
CALCIUM	50.000	50.000	50.000	.000
IRON	.010	.010	.010	.000
MAGNESIUM	5.000	8.000	3.000	.000
MANGANESE	.005	.001	.001	.000
POTASSIUM	<.100	<.100	<.100	.000
SILICA	1.000	2.000	1.000	.000
SODIUM	.250	.350	.250	.000
STRONTIUM	.500	.500	.500	.000
ANTIMONY	<1.000	<1.000	<1.000	.000
ARSENIC	<1.000	<1.000	<1.000	.000
BERYLLIUM	<1.000	<1.000	<1.000	.000
BISMUTH	<1.000	<1.000	<1.000	.000
BORON	.003	.010	.003	.000
CADMIUM	<1.000	<1.000	<1.000	.000
CHROMIUM	.001	.002	.002	.000
COBALT	<1.000	<1.000	<1.000	.000
COPPER	.010	.005	.005	.000
LEAD	.001	<.001	<.001	.000

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	SPRING BOX	RES.MON.W.	RES.W.BKG	MON.WELL 4
MOLYBDENUM	<1.000	<1.000	<1.000	.000
NICKEL	.002	<.001	<.001	.000
SILVER	.001	.001	.001	.000
TIN	<1.000	<1.000	<1.000	.000
TITANIUM	<1.000	<1.000	<1.000	.000
TUNGSTEN	<1.000	<1.000	<1.000	.000
VANADIUM	<1.000	<1.000	<1.000	.000
ZINC	.002	.002	.001	.000
ZIRCONIUM	<1.000	<1.000	<1.000	.000
GERMANIUM	<1.000	<1.000	<1.000	.000
TELLURIUM	<1.000	<1.000	<1.000	.000

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	SPRING BOX	RES.MON.W.	RES.W.BKG	MON.WELL 4
CADMIUM	.00	.00	.00	.00
CHROMIUM	.00	<.01	<.01	<.01
COPPER	.05	.03	<.01	<.01
IRON, TOTAL	.15	.05	.10	.03
MANGANESE	<.01	.00	.00	.53
NICKEL	<.03	.00	.00	.00
LEAD	<.03	.00	.00	<.03
ZINC	.00	.00	.00	.00
BARIUM	<.10	.10	.10	.50
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	.00	.00	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

SAMPLE NO.	SPRING BOX	RES.MON.W.	RES.W.BKG	MON.WELL 4
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1700	.1100	.1000	.0000
CYANIDE	<,0050	<.0050	<.0050	.0000
PHENOLS	,0090	.0100	.0070	,0000
MERCURY	<,0005	<.0005	<.0005	<.0005
ARSENIC	<,0300	<.0300	<,0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	.0100	<,0100	<.0100	<.0100
SULFATE	22,000	16,000	9,100	.000
CALCIUM	71.000	80.000	91,000	78.000
MAGNESIUM	9,200	16.000	20.000	39.000
CHLORIDE	<2,000	<2,000	<2.000	.000
PHOSPHATE	.009	,010	.040	,000
POTASSIUM	.300	,460	1,200	3,600
SODIUM	1,900	2,400	1,800	12,000

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

SAMPLE SPRING BOX

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

SAMPLE RES.MON.W.

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

20 FT DEEP DUG WELL

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 750 FT

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

SAMPLE RES.W.BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

20 FT DEEP DUG WELL, BACKGROUND WELL

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 2200 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-2 , NY

SAMPLE MON,WELL 4

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES

REMARKS

MODERATE ORGANIC ODOR (PETROLEUM?)

SAMPLE VERY TURBID

MONITOR WELL 4 NEAR MACHINE BARN, LEACHATE

TOTAL WELL DEPTH: 14 FT

DISTANCE FROM DISPOSAL AREA: 750 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE NO.	GARAGE	WELL 1	WELL 2	WELL 3
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	11/23/76	11/23/76	11/23/76	11/23/76
TIME	10:20	11:00	11:45	15:30
TEMPERATURE		96.0	10.4	8.0
PH	7.3	6.2	5.4	7.5
SPECIFIC CONDUCTANCE	140	72	480	287
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.750	2.000	.050	2.000
BARIUM	.010	.010	.005	.005
CALCIUM	50.000	50.000	50.000	50.000
IRON	.250	.250	.250	.250
MAGNESIUM	8.000	5.000	8.000	8.000
MANGANESE	.005	.010	2.500	.030
POTASSIUM	.100	.100	.200	.400
SILICA	15.000	25.000	5.000	25.000
SODIUM	5.000	.500	15.000	5.000
STRONTIUM	2.500	.500	1.000	.250
ANTIMONY	<1.000	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000	<1.000
BORON	.010	.010	.003	.010
CADMIUM	<1.000	<1.000	<1.000	<1.000
CHROMIUM	.003	.010	.030	.003
COBALT	.002	.002	.003	.002
COPPER	.030	.010	.003	.010
LEAD	.002	.001	.001	.002

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE NO.	GARAGE	WELL 1	WELL 2	WELL 3
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	<1.000	<1.000	<1.000
NICKEL	.003	.005	.010	.003
SILVER	.001	.001	.002	.002
TIN	<1.000	<1.000	<1.000	<1.000
TITANIUM	.010	.100	<.001	.150
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000	<1.000
ZINC	.002	<.001	<.001	.002
ZIRCONIUM	<.002	<.002	<.002	.010
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	<.01	<.01
COPPER	<.01	<.01	<.01	<.01
IRON, TOTAL	.12	.31	3.90	.47
MANGANESE	.00	.00	4.60	.06
NICKEL	<.03	<.03	<.03	<.03
LEAD	<.10	.00	.00	.00
ZINC	.00	.00	.00	.00
BARIUM	<.10	<.10	<.10	<.10
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	<.01	.00	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE NO.	GARAGE	WELL 1	WELL 2	WELL 3
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0900	.0700	.0600	.1300
CYANIDE	<.0050	<.0050	.0080	<.0050
PHENOLS	.0020	.0200	.4500	.0040
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	<.0100	<.0100	<.0100	.0200
SULFATE	12.000	3.300	2.500	14.000
CALCIUM	40.000	31.000	45.000	60.000
MAGNESIUM	6.800	2.000	4.500	13.000
CHLORIDE	13.000	3.000	75.000	2.000
PHOSPHATE	.030	.020	<.003	.050
POTASSIUM	.590	.310	1.100	.840
SODIUM	.590	.330	.980	.820

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE GARAGE

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED TANNERY WASTE (CHROMATE, SULFURIC ACID)

TOTAL WELL DEPTH: 90 FT

DISTANCE FROM DISPOSAL AREA: 0 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED TANNERY WASTE (CHROMATE, SULFURIC ACID)

SAMPLE CLEAR

TOTAL WELL DEPTH: 12 FT

DISTANCE FROM DISPOSAL AREA: 175 FT

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: .22 PHENOL,APPX .01 ANOTHER UNIDENTIFIED ORGANIC

REMARKS

ODOR OF FORMALIN

SITE ACCEPTED TANNERY WASTE (CHROMATE, SULFURIC ACID)

SAMPLE CLEAR

TOTAL WELL DEPTH: 14 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED TANNERY WASTE (CHROMATE, SULFURIC ACID)

SAMPLE CLEAR

LEACHATE

TOTAL WELL DEPTH: 25 FT

DISTANCE FROM DISPOSAL AREA: 800 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE NO.	RES.BKG			
	----------	----------	----------	----------
DISPOSAL TYPE	LANDFILL			
WATER TYPE	GROUND			
DATE SAMPLED	11/23/76			
TIME	10:00			
TEMPERATURE	10.0			
PH	7.6			
SPECIFIC CONDUCTANCE	392			
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.001
BARIUM	.001
CALCIUM	50.000
IRON	.010
MAGNESIUM	8.000
MANGANESE	.001
POTASSIUM	.100
SILICA	1.000
SODIUM	10.000
STRONTIUM	1.000
ANTIMONY	<1.000
ARSENIC	<1.000
BERYLLIUM	<1.000
BISMUTH	<1.000
BORON	.002
CADMIUM	<1.000
CHROMIUM	.003
COBALT	<.001
COPPER	.010
LEAD	.001

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE NO.	RES.BKG			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000
NICKEL	.003
SILVER	.002
TIN	<1.000
TITANIUM	.001
TUNGSTEN	<1.000
VANADIUM	<1.000
ZINC	.003
ZIRCONIUM	<.002
GERMANIUM	<1.000
TELLURIUM	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00
CHROMIUM	<.01
COPPER	<.01
IRON, TOTAL	.06
MANGANESE	.00
NICKEL	<.03
LEAD	<.10
ZINC	.00
BARIUM	<.10
BERYLLIUM	.00
COBALT	.00
MOLYBDENUM	.00
TIN	.00
VANADIUM	.00

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE NO.	RFS,BKG			

G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	.0500			
CYANIDE	<.0050			
PHENOLS	.0080			
MERCURY	<.0005			
ARSENIC	<.0300			
CHROMIUM+6	<.0100			
SELENIUM	<.0100			
SULFATE	15.000			
CALCIUM	75.000			
MAGNESIUM	19.000			
CHLORIDE	111.000			
PHOSPHATE	.020			
POTASSIUM	1.100			
SODIUM	1.000			

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-3 , NY

SAMPLE RES.BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED TANNERY WASTE (CHROMATE, SULFURIC ACID)

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 750 FT

BACKGROUND WELL

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-4 , NY

SAMPLE NO.	WELL 5 BKG	WELL 3	WELL 1	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	12/29/76	12/29/76	12/29/76	
TIME	11:30	13:00	14:30	
TEMPERATURE	11.0	14.0	12.8	
PH	7.6	7.5	7.9	
SPECIFIC CONDUCTANCE	400	470	250	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.010	1.000	3.000
BARIUM	<.001	.005	.010
CALCIUM	15.000	50.000	50.000
IRON	.050	.250	.250
MAGNESIUM	.500	5.000	5.000
MANGANESE	.003	.250	.250
POTASSIUM	.100	.100	.150
SILICA	2.000	20.000	25.000
SODIUM	50.000	2.000	3.000
STRONTIUM	.005	1.000	1.000
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.010	.001	.005
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.002	.005	.010
COBALT	<1.000	.002	.003
COPPER	.010	.002	.003
LEAD	.001	.001	.002

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-4 , NY

SAMPLE NO.	WELL 5 BKG	WELL 3	WELL 1	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	<1.000	<1.000	
NICKEL	.003	.002	.003	
SILVER	.001	.001	.002	
TIN	<1.000	<1.000	<1.000	
TITANIUM	<1.000	.050	.050	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	<.001	<1.000	<1.000	
ZIRCONIUM	<1.000	.002	<.002	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	<.01	
COPPER	<.01	.00	.00	
IRON, TOTAL	.03	3.70	2.90	
MANGANESE	<.01	.99	.35	
NICKEL	<.03	<.03	<.03	
LEAD	<.03	.00	.00	
ZINC	.00	.00	.00	
BARIUM	.00	.10	.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.01	.01	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-4 , NY

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 5 BKG	WELL 3	WELL 1	
FLUORIDE	.1300	.1500	.1800	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0010	.0200	.0200	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	150.000	290.000	50.000	
CALCIUM	17.000	190.000	75.000	
MAGNESIUM	.320	37.000	11.000	
CHLORIDE	12.000	15.000	8.200	
PHOSPHATE	.009	.010	.030	
POTASSIUM	.170	1.900	2.200	
SODIUM	170.000	15.000	12.000	

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-4 , NY

SAMPLE WELL 5 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

H2S ODOR

SAMPLE CLEAR

PROBABLY BEDROCK WELL, BACKGROUND WELL

TOTAL WELL DEPTH: 73 FT

DISTANCE FROM DISPOSAL AREA: 2300 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-4 , NY

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE SLIGHTLY TURBID

MONITOR WELL 3, LEACHATE

TOTAL WELL DEPTH: 65 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-4 , NY

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE TURBID

MONITOR WELL 1

TOTAL WELL DEPTH: 70 FT

DISTANCE FROM DISPOSAL AREA: 2000 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE NO.	MON,WELL 8	MON,WELL 2	MON,W,7-2	PUB,SUPPLY
DISPOSAL TYPE	COMB	COMB	COMB	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	11/23/76	11/23/76	11/23/76	1/12/77
TIME	10:35	9 50	10:15	16:15
TEMPERATURE	11,1	11,1	11,1	12,6
PH	6,4	7,3	6,8	7,3
SPECIFIC CONDUCTANCE	350	380	300	51
DISSOLVED OXYGEN				.10

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.005	.005	.002	.500
BARIUM	.010	.005	.001	.001
CALCIUM	50,000	50,000	50.000	15,000
IRON	.030	.010	.010	.200
MAGNESIUM	10,000	10,000	8.000	.500
MANGANESE	.030	.003	.003	.010
POTASSIUM	.250	.250	.200	.250
SILICA	1,000	2,000	1,000	50,000
SODIUM	10,000	10,000	8,000	15,000
STRONTIUM	1,000	.500	.250	.250
ANTIMONY	<1,000	<1,000	<1,000	<1,000
ARSENIC	<1,000	<1,000	<1,000	<1,000
BERYLLIUM	<1,000	<1,000	<1,000	<1,000
BISMUTH	<1,000	<1,000	<1,000	<1,000
BORON	.010	.100	.002	.010
CADMIUM	<1,000	<1,000	<1,000	<1,000
CHROMIUM	.002	.002	<.001	.020
COBALT	.003	.002	.002	.050
COPPER	.005	.003	.100	.005
LEAD	.001	.001	.001	.001

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE NO.	MON.WELL 8	MON.WELL 2	MON.W.7-2	PUB.SUPPLY
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	<1.000	<1.000	<1.000
NICKEL	.002	.002	.002	.010
SILVER	.001	.001	.002	.002
TIN	<1.000	<1.000	<1.000	<1.000
TITANIUM	<.001	<.001	<.001	.002
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<.001	<.001	<1.000	<.001
ZINC	.001	.001	<.001	<1.000
ZIRCONIUM	<.002	<.002	<.002	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	.00	<.01
COPPER	.05	<.01	.80	<.01
IRON, TOTAL	.25	.05	.01	<.01
MANGANESE	.26	.00	<.01	.00
NICKEL	.00	<.03	<.03	<.03
LEAD	.00	<.10	.00	<.03
ZINC	.00	.00	.00	.00
BARIUM	<.10	<.10	<.10	.00
BERYLLIUM	.00	.00	.00	.00
COBALT	<.01	.00	<.01	<.01
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

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ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE NO.	MON.WELL 8	MON.WELL 2	MON.W.7-2	PUB.SUPPLY
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0400	.0500	.0500	.1000
CYANIDE	<.0050	<.0050	<.0050	<.0050
PHENOLS	.0100	.0200	.0500	.0110
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	<.0100	<.0100	.0100	<.0100
SULFATE	40.000	65.000	50.000	<1.000
CALCIUM	25.000	35.000	25.000	2.800
MAGNESIUM	9.700	11.000	11.000	.350
CHLORIDE	54.000	52.000	22.000	4.000
PHOSPHATE	<.003	.005	.020	.009
POTASSIUM	2.200	1.400	1.700	.430
SODIUM	27.000	31.000	14.000	11.000

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE MON,WELL 8

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

TOTAL WELL DEPTH: 455 FT

DISTANCE FROM DISPOSAL AREA: 1700 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE MON.WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

PUBLIC SUPPLY WELL

TOTAL WELL DEPTH: 423 FT

DISTANCE FROM DISPOSAL AREA: 1,000 FT.

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE MON.W.7-2

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

PUBLIC SUPPLY PRODUCTION WELL

TOTAL WELL DEPTH: 555 FT

DISTANCE FROM DISPOSAL AREA: 5000 FT

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE PUB,SUPPLY

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001,TOTAL CONC, ,001

PESTICIDES
ELECTRONEGATIVE COMPOUNDS PRESENT<,001,TOTAL CONC, ,001

VOLATILES
HEAVY ORGANICS: <,01, LIGHT VOLATILES: <1

REMARKS

FROM FIRE HYDRANT

VERY COLD WEATHER,WATER SAMPLE COOLED TO 3C

TOTAL WELL DEPTH: COMBINATION OF PUBLIC SUPPLY WELLS

DISTANCE FROM DISPOSAL AREA: COMBINATION OF PUBLIC SUPPLY WELLS

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE NO.	SETTING 1	SETTING 2	SETTING 3	
DISPOSAL TYPE	COMB	COMB	COMB	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	1/12/77	1/19/77	1/25/77	
TIME	17:00	15:00	12:00	
TEMPERATURE	14.0	10.0	9.0	
PH	5.9	5.7	7.2	
SPECIFIC CONDUCTANCE	400	640	47	
DISSOLVED OXYGEN		.02	.11	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	3.000	3.000	8.000
BARIUM	.030	.020	.020
CALCIUM	8.000	8.000	8.000
IRON	.200	.250	5.000
MAGNESIUM	.500	3.000	.250
MANGANESE	.010	.005	.020
POTASSIUM	.150	.500	.500
SILICA	50.000	50.000	50.000
SODIUM	3.000	5.000	3.000
STRONTIUM	.250	.150	.050
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.050	.050	.020
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.005	.010	.050
COBALT	.002	.002	.001
COPPER	.005	.020	.010
LEAD	.003	.002	.001

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE NO.	SETTING 1	SETTING 2	SETTING 3

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000	<1.000	<1.000
NICKEL	.002	.005	.010
SILVER	<.001	<1.000	.001
TIN	<1.000	<1.000	.001
TITANIUM	.250	.200	.500
TUNGSTEN	<1.000	<1.000	<1.000
VANADIUM	.003	.003	.010
ZINC	<1.000	<1.000	.001
ZIRCONIUM	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00
CHROMIUM	<.01	<.01	<.01
COPPER	<.01	<.01	<.01
IRON, TOTAL	.25	.69	.02
MANGANESE	.05	.00	.00
NICKEL	.00	.03	<.03
LEAD	<.03	.00	.00
ZINC	.00	.00	.00
BARIUM	<.10	<.10	<.10
BERYLLIUM	.00	.00	.00
COBALT	.00	.00	.00
MOLYBDENUM	.00	.00	.00
TIN	.00	.00	.00
VANADIUM	.00	<.08	<.08

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	SETTING 1	SETTING 2	SETTING 3	
FLUORIDE	.3600	.2900	.1000	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	<.0010	.0020	<.0010	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	70.000	165.000	.080	
CALCIUM	36.000	60.000	9.800	
MAGNESIUM	9.000	19.000	.550	
CHLORIDE	65.000	104.000	6.100	
PHOSPHATE	.050	.060	.150	
POTASSIUM	1.700	3.000	.350	
SODIUM	57.000	100.000	3.900	

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE SETTING 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001,TOTAL CONC. .001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SCREEN SETTING 189-209 FT BELOW L.S.

SAMPLE MODERATELY TURBID

POSSIBLE BREACH OF CLAY SEAL ABOVE SCREEN,TEST WELL

EXTREMELY COLD WEATHER (-10 F)

TOTAL WELL DEPTH: 209 FT

DISTANCE FROM DISPOSAL AREA: 200 FT.

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE SETTING 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SCREEN SETTING 358-378 FT BELOW L.S.

SAMPLE VERY TURBID

LEACHATE, TEST WELL

TOTAL WELL DEPTH: 378 FT

DISTANCE FROM DISPOSAL AREA: 200 FT.

ANALYSIS OF WATER SAMPLES FROM

NEW YORK S-5 , NY

SAMPLE SETTING 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SCREEN SETTING 525-545 FT BELOW L.S.

SAMPLE QUITE CLEAR

LEACHATE,TEST WELL

TOTAL WELL DEPTH: 545 FT

DISTANCE FROM DISPOSAL AREA: 200 FT.

ANALYSIS OF WATER SAMPLES FROM

PENN. S-1 , PA

SAMPLE NO.	WELL 5 BKG	WELL 1	WELL 3	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	12/2/76	12/2/76	12/2/76	
TIME	12:00	13:00	14:30	
TEMPERATURE	11.4	14.4	10.0	
PH	6.3	5.1	4.7	
SPECIFIC CONDUCTANCE	79	245	118	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	1.000	.003	.000
BARIUM	.010	.200	.000
CALCIUM	50.000	50.000	.000
IRON	1.000	.250	.000
MAGNESIUM	10.000	10.000	.000
MANGANESE	.100	1.500	.000
POTASSIUM	1.000	1.000	.000
SILICA	20.000	1.000	.000
SODIUM	5.000	10.000	.000
STRONTIUM	2.000	1.000	.000
ANTIMONY	<1.000	<1.000	.000
ARSENIC	<1.000	<1.000	.000
BERYLLIUM	<1.000	<1.000	.000
BISMUTH	<1.000	<1.000	.000
BORON	.010	.010	.000
CADMIUM	<1.000	<1.000	.000
CHROMIUM	.020	.010	.000
COBALT	.002	.010	.000
COPPER	.010	.010	.000
LEAD	.003	.003	.000

ANALYSIS OF WATER SAMPLES FROM

PENN, S-1 , PA

SAMPLE NO.	WELL 5 BKG	WELL 1	WELL 3	
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	<1.000	.000	
NICKEL	.005	.010	.000	
SILVER	.005	.003	.000	
TIN	.002	<1.000	.000	
TITANIUM	.003	<.001	.000	
TUNGSTEN	<1.000	<1.000	.000	
VANADIUM	<1.000	<1.000	.000	
ZINC	.003	.002	.000	
ZIRCONIUM	<1.000	<1.000	.000	
GERMANIUM	<1.000	<1.000	.000	
TELLURIUM	<1.000	<1.000	.000	
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	.00	
COPPER	<.01	.00	.00	
IRON, TOTAL	.11	1.70	.00	
MANGANESE	.01	3.10	.00	
NICKEL	<.03	<.03	.00	
LEAD	.00	.00	.00	
ZINC	.00	.00	.00	
BARIUM	<.10	<.10	.00	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.01	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

PENN. S-1 , PA

SAMPLE NO.	WELL 5 BKG	WELL 1	WELL 3	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.0500	.0400	.0400	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	<.0010	.0200	.0600	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	<1.000	1.700	1.000	
CALCIUM	22.000	30.000	22.000	
MAGNESIUM	3.200	11.000	4.300	
CHLORIDE	3.000	61.000	4.000	
PHOSPHATE	.030	.050	.060	
POTASSIUM	.370	1.800	1.300	
SODIUM	1.700	22.000	3.600	

ANALYSIS OF WATER SAMPLES FROM

PENN, S-1 , PA

SAMPLE WELL 5 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

IRON PPTED

SAMPLE CLEAR

BACKGROUND WELL

TOTAL WELL DEPTH: 150 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

PENN, S-1 , PA

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR

MONITOR WELL 1, LEACHATE

TOTAL WELL DEPTH: 40 FT

DISTANCE FROM DISPOSAL AREA: 300 FT

4

ANALYSIS OF WATER SAMPLES FROM

PENN, S-1 , PA

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE TURBID

MONITOR WELL 3, LEACHATE

TOTAL WELL DEPTH: 80 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

PENN. S-2 , PA

SAMPLE NO.	BKG	MON.WELL		
DISPOSAL TYPE	LANDFILL	LANDFILL		
WATER TYPE	GROUND	GROUND		
DATE SAMPLED	12/3/76	12/3/76		
TIME	9 00	12:00		
TEMPERATURE	8.0	12.8		
PH	6.5	7.0		
SPECIFIC CONDUCTANCE	1530	748		
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.020	.250
BARIUM	.001	.001
CALCIUM	50.000	50.000
IRON	.005	.200
MAGNESIUM	8.000	8.000
MANGANESE	.003	.100
POTASSIUM	.100	.100
SILICA	1.000	1.000
SODIUM	5.000	5.000
STRONTIUM	1.000	1.000
ANTIMONY	<1.000	<1.000
ARSENIC	<1.000	<1.000
BERYLLIUM	<1.000	<1.000
BISMUTH	<1.000	<1.000
BORON	.003	.003
CADMIUM	<1.000	<1.000
CHROMIUM	.030	.010
COBALT	<.001	<.001
COPPER	.003	.002
LEAD	.003	.001

ANALYSIS OF WATER SAMPLES FROM

PENN. S-2 , PA

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

SAMPLE NO.	BKG	MON.WELL		
MOLYBDENUM	<1.000	<1.000		
NICKEL	.001	.001		
SILVER	.001	.001		
TIN	<1.000	<1.000		
TITANIUM	<.001	.002		
TUNGSTEN	<1.000	<1.000		
VANADIUM	<1.000	<1.000		
ZINC	.001	.001		
ZIRCONIUM	<1.000	<1.000		
GERMANIUM	<1.000	<1.000		
TELLURIUM	<1.000	<1.000		

QUANTITATIVE METALS RESULTS, MG/L

SAMPLE NO.	BKG	MON.WELL		
CADMIUM	.00	.00		
CHROMIUM	<.01	<.01		
COPPER	.01	.01		
IRON, TOTAL	.15	1.40		
MANGANESE	.00	.03		
NICKEL	<.03	<.03		
LEAD	<.10	.00		
ZINC	.00	.00		
BARIUM	<.10	<.10		
BERYLLIUM	.00	.00		
COBALT	.00	.00		
MOLYBDENUM	.00	.00		
TIN	.00	.00		
VANADIUM	.00	.00		

ANALYSIS OF WATER SAMPLES FROM

PENN. S-2 , PA

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	BKG	MON.WELL		
FLUORIDE	.0500	.0500		
CYANIDE	<.0050	<.0050		
PHENOLS	.0100	.0040		
MERCURY	<.0005	<.0005		
ARSENIC	<.0300	<.0300		
CHROMIUM+6	<.0100	<.0100		
SELENIUM	<.0100	<.0100		
SULFATE	210.000	85.000		
CALCIUM	340.000	200.000		
MAGNESIUM	5.600	24.000		
CHLORIDE	271.000	90.000		
PHOSPHATE	.050	.020		
POTASSIUM	2.000	1.300		
SODIUM	11.000	43.000		

ANALYSIS OF WATER SAMPLES FROM

PENN, S-2 , PA

SAMPLE BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01, LIGHT VOLATILES:<1

REMARKS

SITE ACCEPTED INCINERATOR RESIDUE

SAMPLE CLEAR

BACKGROUND WELL

TOTAL WELL DEPTH: 105 FT

DISTANCE FROM DISPOSAL AREA: 650 FT

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ANALYSIS OF WATER SAMPLES FROM

PENN, S-2 , PA

SAMPLE MON.WELL

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED INCINERATOR RESIDUE

SAMPLE CLEAR

MONITOR WELL, LEACHATE

TOTAL WELL DEPTH: 24 FT

DISTANCE FROM DISPOSAL AREA: 150 FT

4

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-1 , WI

SAMPLE NO.	WELL NE	WELL 13BKG	WELL W	
DISPOSAL TYPE	LAGOON	LAGOON	LAGOON	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	10/20/76	10/19/76	10/19/76	
TIME	10:00	15:00		
TEMPERATURE	10.5	96.0	86.0	
PH	7.6	7.6	7.6	
SPECIFIC CONDUCTANCE	1800	640	460	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.100	.020	.030
BARIUM	.010	.005	.050
CALCIUM	50.000	50.000	50.000
IRON	.200	.005	.005
MAGNESIUM	20.000	15.000	10.000
MANGANESE	.010	.005	.005
POTASSIUM	.000	.000	.000
SILICA	5.000	5.000	5.000
SODIUM	3.000	1.000	3.000
STRONTIUM	.100	.100	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.002	<.001	.005
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.002	.002
COBALT	<1.000	<1.000	<1.000
COPPER	.020	.003	.005
LEAD	.001	.001	.001

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-1 , WI

SAMPLE NO.	WELL NE	WELL 13BKG	WELL W	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1.000	<1.000	<1.000	
NICKEL	.005	.002	.002	
SILVER	.003	.001	.010	
TIN	<1.000	<1.000	<1.000	
TITANIUM	.005	.001	.003	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	<1.000	<1.000	<1.000	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	<.01	
COPPER	<.01	<.01	<.01	
IRON, TOTAL	.05	<.01	<.01	
MANGANESE	.00	.17	.04	
NICKEL	<.03	<.03	<.03	
LEAD	<.10	.00	.00	
ZINC	.00	.00	.00	
BARIUM	.10	<.10	<.10	
BERYLLIUM	.00	.00	.00	
COBALT	.00	.00	.00	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-1 , WI

SAMPLE NO.	WELL NE	WELL 13BKG	WELL W	
	G4 AND G5 GROUP RESULTS, MG/L			
FLUORIDE	.2200	.1600	.3300	
CYANIDE	<.0050	<.0050	<.0050	
PHENOLS	.0300	.0200	.0400	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	<.0100	
SULFATE	705.000	125.000	10.000	
CALCIUM	330.000	95.000	60.000	
MAGNESIUM	200.000	64.000	46.000	
CHLORIDE	<2.000	20.000	2.000	
PHOSPHATE	.170	.040	.050	
POTASSIUM	1.800	1.500	2.100	
SODIUM	19.000	5.400	13.000	

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-1 , WI

SAMPLE WELL NE

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

PPT IN CN BOTTLE

SITE ACCEPTED ALUM SLUDGE (SULFATE, ALUMINUM,HEAVY METALS)

TOTAL WELL DEPTH: APPROXIMATELY 35 FT.

DISTANCE FROM DISPOSAL AREA: 150 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-1 , WI

SAMPLE WELL 13BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED ALUM SLUDGE (SULFATE,ALUMINUM,HEAVY METALS)

POSSIBLE BACKGROUND

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-1 , WI

SAMPLE WELL W

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ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED ALUM SLUDGE (SULFATE,ALUMINUM,HEAVY METALS)

TOTAL WELL DEPTH: APPROXIMATELY 35 FT.

DISTANCE FROM DISPOSAL AREA: 200 FT

11

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-2 , WI

SAMPLE NO.	WELL B BKG	WELL P	WELL 6A
DISPOSAL TYPE	COMB	COMB	COMB
WATER TYPE	GROUND	GROUND	GROUND
DATE SAMPLED	10/25/76	10/25/76	10/25/76
TIME	15:00	14:00	18:15
TEMPERATURE	16.2	11.3	11.5
PH	7.7	7.4	7.3
SPECIFIC CONDUCTANCE	400	570	825
DISSOLVED OXYGEN			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.030	.003	.030
BARIUM	.002	.010	.010
CALCIUM	50.000	50.000	50.000
IRON	.500	.250	.500
MAGNESIUM	10.000	10.000	10.000
MANGANESE	.005	.010	.020
POTASSIUM	.100	.100	.100
SILICA	5.000	2.000	3.000
SODIUM	1.000	.200	3.000
STRONTIUM	.050	.050	.050
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.002	.002	.010
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.002	.002	.002
COBALT	<.001	<.001	<.001
COPPER	.010	.010	.010
LEAD	<.001	.003	.001

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-2 , WI

SAMPLE NO.	WELL B BKG	WELL P	WELL 6A	
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EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

	WELL B BKG	WELL P	WELL 6A
MOLYBDENUM	<1,000	<1,000	<1,000
NICKEL	,020	,001	,010
SILVER	,003	,010	,001
TIN	<,001	<,001	<,001
TITANIUM	,003	,010	.002
TUNGSTEN	<1,000	<1,000	<1,000
VANADIUM	<1,000	<1,000	<1,000
ZINC	<,001	<,001	,010
ZIRCONIUM	<1,000	<1,000	<1,000
GERMANIUM	<1,000	<1,000	<1,000
TELLURIUM	<1,000	<1,000	<1,000

QUANTITATIVE METALS RESULTS, MG/L

	WELL B BKG	WELL P	WELL 6A
CADMIUM	,00	,00	,00
CHROMIUM	<,01	<,01	<,01
COPPER	<,01	,00	<,01
IRON, TOTAL	<,01	1,90	<,01
MANGANESE	,00	,11	.32
NICKEL	<,03	<,03	,04
LEAD	,00	<,10	,00
ZINC	,00	,00	,00
BARIUM	<,10	<,10	,10
BERYLLIUM	,00	,00	,00
COBALT	,00	,00	,00
MOLYBDENUM	,00	,00	,00
TIN	,00	,00	,00
VANADIUM	,00	,00	,00

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-2 , WI

SAMPLE NO.	WELL B BKG	WELL P	WELL 6A	
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.1700	.1600	.1900	
CYANIDE	<.0050	<.0050	.0000	
PHENOLS	.0100	.0090	.0400	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	<.0100	.0200	
SULFATE	28.000	28.000	28.000	
CALCIUM	45.000	80.000	83.000	
MAGNESIUM	44.000	55.000	73.000	
CHLORIDE	15.000	8.000	26.000	
PHOSPHATE	.050	.100	.070	
POTASSIUM	1.500	1.900	15.000	
SODIUM	9.300	6.900	14.000	

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-2 , WI

SAMPLE WELL B BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE, HEAVY METALS

SAMPLE CLEAR

MONITOR WELL IN QUARRY FLOOR, BACKGROUND

TOTAL WELL DEPTH: 14 FT

DISTANCE FROM DISPOSAL AREA: 2300 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-2 , WI

SAMPLE WELL P

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE,HEAVY METALS

SAMPLE CLEAR

INDUSTRIAL SUPPLY WELL, BACTERIAL CONTAMINATION IN LEACHATE SUSPECTED

TOTAL WELL DEPTH: 90 FT

DISTANCE FROM DISPOSAL AREA: 900 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-2 , WI

SAMPLE WELL 6A

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE, HEAVY METALS

MONITOR WELL 6A, AT SW CORNER OF ASH LAGOONS

TOTAL WELL DEPTH: 95 FT

DISTANCE FROM DISPOSAL AREA: 30 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-3 , WI

SAMPLE NO.	WELL 5			
	----------	----------	----------	----------
DISPOSAL TYPE	COMM			
WATER TYPE	GROUND			
DATE SAMPLED	10/22/76			
TIME	14:00			
TEMPERATURE	15.4			
PH	7.1			
SPECIFIC CONDUCTANCE	950			
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	3.000
BARIUM	.100
CALCIUM	50.000
IRON	.150
MAGNESIUM	15.000
MANGANESE	.100
POTASSIUM	.100
SILICA	15.000
SODIUM	3.000
STRONTIUM	.250
ANTIMONY	<1.000
ARSENIC	<1.000
BERYLLIUM	<1.000
BISMUTH	<1.000
BORON	.100
CADMIUM	<1.000
CHROMIUM	.010
COBALT	.001
COPPER	.050
LEAD	.002

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-3 , WI

SAMPLE NO.	WELL 5			

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	<1,000
NICKEL	,020
SILVER	,050
TIN	<1,000
TITANIUM	,050
TUNGSTEN	<1,000
VANADIUM	<1,000
ZINC	,001
ZIRCONIUM	<1,000
GERMANIUM	<1,000
TELLURIUM	<1,000

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	,00
CHROMIUM	<,01
COPPER	<,01
IRON, TOTAL	,37
MANGANESE	1,20
NICKEL	,08
LEAD	,00
ZINC	,00
BARIUM	<,10
BERYLLIUM	,00
COBALT	,00
MOLYBDENUM	,00
TIN	,00
VANADIUM	,00

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-3 , WI

SAMPLE NO.	WELL 5			

G4 AND G5 GROUP RESULTS, MG/L

FLUORIDE	.2000
CYANIDE	<.0050
PHENOLS	.0400
MERCURY	<.0005
ARSENIC	<.0300
CHROMIUM+6	<.0100
SELENIUM	<.0100
SULFATE	83.000
CALCIUM	140.000
MAGNESIUM	92.000
CHLORIDE	64.000
PHOSPHATE	.170
POTASSIUM	1.500
SODIUM	29.000

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-3 , WI

SAMPLE WELL 5

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PHENOLIC RESINS & PLATING WASTES

SAMPLE CLEAR

MONITOR WELL 5, 10 FT SOUTH OF FILLED OIL PIT

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 10 FT

4

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE NO.	WELL 7	WELL 8	WELL 22	WELL 25 BKG
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	10/28/76	10/28/76	10/28/76	10/28/76
TIME	10:30	14:30	13:30	12:30
TEMPERATURE				
PH	7,2	7,1	7,2	7,2
SPECIFIC CONDUCTANCE	740	300	2700	800
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.100	.020	.050	.100
BARIUM	.002	<,001	.010	.005
CALCIUM	50,000	50,000	50,000	50,000
IRON	.020	.005	.010	.020
MAGNESIUM	15,000	12,000	15,000	15,000
MANGANESE	.010	.010	.010	.020
POTASSIUM	.100	.100	3,000	.100
SILICA	5,000	3,000	3,000	5,000
SODIUM	2,000	1,000	15,000	2,000
STRONTIUM	.500	.250	1,000	.200
ANTIMONY	<1,000	<1,000	<1,000	<1,000
ARSENIC	<1,000	<1,000	<1,000	<1,000
BERYLLIUM	<1,000	<1,000	<1,000	<1,000
BISMUTH	<1,000	<1,000	<1,000	<1,000
BORON	.003	.003	.003	.005
CADMIUM	<1,000	<1,000	<1,000	<1,000
CHROMIUM	.001	.002	.001	.002
COBALT	.001	.001	.001	.001
COPPER	.003	.001	.002	.005
LEAD	<,001	<,001	<,001	<,001

483

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE NO.	WELL 7	WELL 8	WELL 22	WELL 25 BKG
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	.001	<.001	.005	<.001
NICKEL	.002	.003	.002	.002
SILVER	.001	.001	<.001	.001
TIN	<1.000	<1.000	<1.000	<1.000
TITANIUM	.003	.010	<.001	.003
TUNGSTEN	<1.000	<1.000	<1.000	<1.000
VANADIUM	<1.000	<1.000	<1.000	<1.000
ZINC	.020	.002	<.001	.002
ZIRCONIUM	<1.000	<1.000	<1.000	<1.000
GERMANIUM	<1.000	<1.000	<1.000	<1.000
TELLURIUM	<1.000	<1.000	<1.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	.00	<.01	.00	<.01
COPPER	<.01	<.01	<.01	<.01
IRON, TOTAL	<.01	<.01	<.01	<.01
MANGANESE	.12	.23	.33	.67
NICKEL	<.03	<.03	<.03	<.03
LEAD	.00	.00	.00	.00
ZINC	1.20	.00	.00	.00
BARIUM	<.10	.00	.50	<.10
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	<.01	.00	.00
MOLYBDENUM	.00	.00	.24	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE NO.	WELL 7	WELL 8	WELL 22	WELL 25	BKG
G4 AND G5 GROUP RESULTS, MG/L.					
FLUORIDE	.3100	.2800	.8200	.5400	
CYANIDE	<.0050	<.0050	<.0050	<.0050	
PHENOLS	.0600	.0300	.0500	.0300	
MERCURY	<.0005	<.0005	<.0005	<.0005	
ARSENIC	.0300	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100	
SELENIUM	.0300	.0100	.0300	.0100	
SULFATE	130.000	145.000	70.000	230.000	
CALCIUM	87.000	94.000	199.000	104.000	
MAGNESIUM	67.000	55.000	110.000	60.000	
CHLORIDE	19.000	39.000	5.100	25.000	
PHOSPHATE	.040	.050	.110	.060	
POTASSIUM	2.400	2.600	49.000	2.300	
SODIUM	7.500	13.000	308.000	11.000	

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE WELL 7

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <,01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE, OILS, SOLVENTS,PESTICIDES

SAMPLE TURBID

MONITOR WELL 7,

TOTAL WELL DEPTH: 39 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

4

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE WELL 8

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE,OILS,SOLVENTS,PESTICIDES

SAMPLE VERY TURBID

MONITOR WELL 8

TOTAL WELL DEPTH: 28 FT

DISTANCE FROM DISPOSAL WELL: 60 FT

487

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE WELL 22

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LT VOLATILES:ONE PEAK APPX 1.2

REMARKS

SITE ACCEPTED PAINT WASTE,OILS,SOLVENTS,PESTICIDES

SAMPLE VERY TURBID

MONITOR WELL 22

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL WELL: 80 FT

45

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-4 , WI

SAMPLE WELL 25 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE,OILS,SOLVENTS,PESTICIDES

SAMPLE VERY TURBID

MONITOR WELL 25, BACKGROUND

TOTAL WELL DEPTH: 20 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-5 , WI

SAMPLE NO.	WELL E BKG	WELL F	SPRING	
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	
WATER TYPE	GROUND	GROUND	GROUND	
DATE SAMPLED	10/21/76	10/21/76	10/21/76	
TIME	15:30	12:00	13:30	
TEMPERATURE		10.8	76.0	
PH	7.6	6.9	7.1	
SPECIFIC CONDUCTANCE	950	1500	1600	
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

ALUMINUM	.500	.010	.030
BARIUM	.003	.010	.010
CALCIUM	50.000	50.000	50.000
IRON	.250	.250	.750
MAGNESIUM	15.000	15.000	15.000
MANGANESE	.050	.010	.050
POTASSIUM	3.000	3.000	2.000
SILICA	5.000	8.000	5.000
SODIUM	10.000	3.000	10.000
STRONTIUM	.500	1.000	.250
ANTIMONY	<1.000	<1.000	<1.000
ARSENIC	<1.000	<1.000	<1.000
BERYLLIUM	<1.000	<1.000	<1.000
BISMUTH	<1.000	<1.000	<1.000
BORON	.050	.010	.030
CADMIUM	<1.000	<1.000	<1.000
CHROMIUM	.003	.005	.002
COBALT	.003	.002	.002
COPPER	.010	.005	.005
LEAD	.001	.002	<.001

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-5 , WI

SAMPLE NO.	WELL F BKG	WELL F	SPRING	

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)

MOLYBDENUM	.002	<1.000	<1.000	
NICKEL	.030	.003	.001	
SILVER	.010	.002	.003	
TIN	.001	<1.000	<.001	
TITANIUM	.010	.002	.002	
TUNGSTEN	<1.000	<1.000	<1.000	
VANADIUM	<1.000	<1.000	<1.000	
ZINC	.010	.002	<.001	
ZIRCONIUM	<1.000	<1.000	<1.000	
GERMANIUM	<1.000	<1.000	<1.000	
TELLURIUM	<1.000	<1.000	<1.000	

QUANTITATIVE METALS RESULTS, MG/L

CADMIUM	.00	.00	.00	
CHROMIUM	<.01	<.01	<.01	
COPPER	<.01	<.01	<.01	
IRON, TOTAL	.02	2.20	.04	
MANGANESE	<.01	.10	1.10	
NICKEL	<.03	.03	.00	
LEAD	.00	.00	.00	
ZINC	.00	.00	.00	
BARIUM	.00	<.10	<.10	
BERYLLIUM	.00	.00	.00	
COBALT	.02	.00	.01	
MOLYBDENUM	.00	.00	.00	
TIN	.00	.00	.00	
VANADIUM	.00	.00	.00	

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-5 , WI

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL E BKG	WELL F	SPRING	
FLUORIDE	.3100	.1100	.1400	
CYANIDE	<.0050	.0060	<.0050	
PHENOLS	.0100	.1000	.0400	
MERCURY	<.0005	<.0005	<.0005	
ARSENIC	<.0300	<.0300	<.0300	
CHROMIUM+6	<.0100	<.0100	<.0100	
SELENIUM	<.0100	.0200	.0200	
SULFATE	275.000	1.000	5.000	
CALCIUM	79.000	180.000	170.000	
MAGNESIUM	120.000	96.000	100.000	
CHLORIDE	5.000	<2.000	<2.000	
PHOSPHATE	.310	.060	.460	
POTASSIUM	3.800	53.000	41.000	
SODIUM	33.000	23.000	85.000	

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-5 , WI

SAMPLE WELL E BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE

MONITOR WELL IN FARM FIELD, BACKGROUND

TOTAL WELL DEPTH: UNKNOWN

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-5 , WI

SAMPLE WELL F

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: .06, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE

SAMPLE LT BROWN

TOTAL WELL DEPTH: APPROXIMATELY 16 FT.

DISTANCE FROM DISPOSAL AREA: 200 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-5 , WI

SAMPLE SPRING

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
UNIDENTIFIED ELECTRONEGATIVE COMPOUNDS PRESENT .002

VOLATILES
HEAVY ORGANICS: <.05, LIGHT VOLATILES: <1

REMARKS

SITE ACCEPTED PAINT WASTE

SAMPLE CLEAR, LT BROWN TINT

SPRING

TOTAL WELL DEPTH: NOT APPLICABLE

DISTANCE FROM DISPOSAL AREA: 300 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-6 , WI

SAMPLE NO.	WELL 1	WELL 2 BKG	WELL 6	WELL 7
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	10/26/76	10/27/76	10/27/76	10/27/76
TIME	15:00	16:00	12:00	15:00
TEMPERATURE	66.0	96.0	13.0	11.0
PH	7.4	7.1	7.4	7.4
SPECIFIC CONDUCTANCE	270	760	540	460
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 2 BKG	WELL 6	WELL 7
ALUMINUM	1.000	.000	1.000	3.000
BARIUM	.001	.000	.010	.100
CALCIUM	20.000	.000	8.000	50.000
IRON	.030	.000	.200	.250
MAGNESIUM	2.000	.000	8.000	15.000
MANGANESE	.020	.000	.010	.050
POTASSIUM	.200	.000	<.100	.200
SILICA	50.000	.000	50.000	25.000
SODIUM	5.000	.000	.250	3.000
STRONTIUM	.200	.000	.250	.750
ANTIMONY	<1.000	.000	<1.000	<1.000
ARSENIC	<1.000	.000	<1.000	<1.000
BERYLLIUM	<1.000	.000	<1.000	<1.000
BISMUTH	<1.000	.000	<1.000	<1.000
BORON	.020	.000	.005	.030
CADMIUM	<1.000	.000	<1.000	<1.000
CHROMIUM	.002	.000	.002	.005
COBALT	<.001	.000	<.001	<.001
COPPER	.010	.000	.010	.030
LEAD	.002	.000	.003	.005

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-6 , WI

SAMPLE NO.	WELL 1	WELL 2 BKG	WELL 6	WELL 7
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	.000	<1.000	<.001
NICKEL	.003	.000	.003	.020
SILVER	.001	.000	.003	.005
TIN	<1.000	.000	<1.000	.005
TITANIUM	.010	.000	.030	.050
TUNGSTEN	<1.000	.000	<1.000	<1.000
VANADIUM	<1.000	.000	<1.000	<1.000
ZINC	.002	.000	.003	.030
ZIRCONIUM	<1.000	.000	<1.000	<1.000
GERMANIUM	<1.000	.000	<1.000	<1.000
TELLURIUM	<1.000	.000	<1.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	<.01	<.01	.03	.00
COPPER	<.01	<.01	<.01	<.01
IRON, TOTAL	.01	.05	.01	<.01
MANGANESE	.01	<.01	.00	.03
NICKEL	<.03	.00	<.03	<.03
LEAD	<.10	.00	<.10	<.10
ZINC	.00	.00	.00	.00
BARIUM	.00	.10	<.10	<.10
BERYLLIUM	.00	.00	.00	.00
COBALT	.00	.01	.00	.00
MOLYBDENUM	.00	.00	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-6 , WI

G4 AND G5 GROUP RESULTS, MG/L

SAMPLE NO.	WELL 1	WELL 2 BKG	WELL 6	WELL 7
FLUORIDE	.9900	.3000	.4300	.9500
CYANIDE	<.0050	.0000	<.0050	.0100
PHENOLS	.0000	.0000	.0100	.0100
MERCURY	<.0005	<.0005	<.0005	<.0005
ARSENIC	<.0300	<.0300	<.0300	<.0300
CHROMIUM+6	<.0100	<.0100	<.0100	<.0100
SELENIUM	.0100	.0200	.0400	<.0100
SULFATE	7.500	60.000	90.000	40.000
CALCIUM	12.000	87.000	57.000	53.000
MAGNESIUM	3.300	60.000	39.000	52.000
CHLORIDE	3.100	4.100	10.000	5.000
PHOSPHATE	.070	.080	.080	.710
POTASSIUM	1.400	3.600	1.600	2.600
SODIUM	35.000	94.000	15.000	8.600

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-6 , WI

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<.001

VOLATILES
HVY O:NUMBER OF PEAKS,APPX TOTAL ,11, LT V: APPX 49

REMARKS

MONITOR WELL B1

TOTAL WELL DEPTH: 44 FT

DISTANCE FROM DISPOSAL AREA: 500 FT

ANALYSIS OF WATER SAMPLES FROM
WISCONSIN S-6 , WI

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS

PESTICIDES

VOLATILES

REMARKS

SAMPLE TURBID

MONITOR WELL B2 , BACKGROUND WELL

TOTAL WELL DEPTH: 41 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-6 , WI

SAMPLE WELL 6

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLEAR, LT BROWN TINT

MONITOR WELL H6 WEST

TOTAL WELL DEPTH: 30 FT

DISTANCE FROM DISPOSAL AREA: 75 FT

501

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-6 , WI

SAMPLE WELL 7

ORGANICS GROUP RESULTS, MG/L

PCBS
<.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01, LIGHT VOLATILES: <1

REMARKS

SAMPLE CLOUDY

MONITOR WELL B7

TOTAL WELL DEPTH: 35 FT

DISTANCE FROM DISPOSAL AREA: 100 FT

51

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 . , WI

SAMPLE NO.	WELL 1	WELL 4 BKG	WELL 2	WELL 3
DISPOSAL TYPE	LANDFILL	LANDFILL	LANDFILL	LANDFILL
WATER TYPE	GROUND	GROUND	GROUND	GROUND
DATE SAMPLED	10/27/76	10/29/76	10/29/76	10/29/76
TIME	15:30	15:00	17:30	16:30
TEMPERATURE	54.0	54.0	54.0	54.0
PH	6.6	6.8	7.2	6.4
SPECIFIC CONDUCTANCE	4250	700	480	2150
DISSOLVED OXYGEN				

EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT

	WELL 1	WELL 4 BKG	WELL 2	WELL 3
ALUMINUM	.005	.050	.000	.003
BARIUM	.250	.250	.000	.005
CALCIUM	50.000	50.000	.000	50.000
IRON	5.000	.020	.000	1.000
MAGNESIUM	20.000	20.0[illegible]	.000	15.000
MANGANESE	1.000	2.000	.000	1.000
POTASSIUM	.200	.250	.000	.250
SILICA	1.000	5.000	.000	1.000
SODIUM	2.000	3.000	.000	1.500
STRONTIUM	.500	1.000	.000	.500
ANTIMONY	<1.000	<1.000	.000	<1.000
ARSENIC	<1.000	<1.000	.000	<1.000
BERYLLIUM	<1.000	<1.000	.000	<1.000
BISMUTH	<1.000	<1.000	.000	<1.000
BORON	.030	.005	.000	.005
CADMIUM	<1.000	<1.000	.000	<1.000
CHROMIUM	.001	.005	.000	.002
COBALT	.002	.002	.000	.003
COPPER	.002	.005	.000	.002
LEAD	<.001	.001	.000	<.001

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 , WI

SAMPLE NO.	WELL 1	WELL 4 BKG	WELL 2	WELL 3
EMISSION SPECTROSCOPY RESULTS OF OXIDES REPORTED IN WEIGHT PERCENT (CONT.)				
MOLYBDENUM	<1.000	.005	.000	<1.000
NICKEL	.002	.010	.000	.002
SILVER	.003	.005	.000	.002
TIN	<1.000	<1.000	.000	<1.000
TITANIUM	.002	.001	.000	.001
TUNGSTEN	<1.000	<1.000	.000	<1.000
VANADIUM	<1.000	<1.000	.000	<1.000
ZINC	<.001	.001	.000	<.001
ZIRCONIUM	<1.000	<1.000	.000	<1.000
GERMANIUM	<1.000	<1.000	.000	<1.000
TELLURIUM	<1.000	<1.000	.000	<1.000
QUANTITATIVE METALS RESULTS, MG/L				
CADMIUM	.00	.00	.00	.00
CHROMIUM	.00	.00	.00	<.01
COPPER	<.01	<.01	.00	<.01
IRON, TOTAL	120.00	<.01	.00	41.00
MANGANESE	32.00	16.00	.00	33.00
NICKEL	<.03	.05	.00	.00
LEAD	.00	.00	.00	.00
ZINC	.00	.00	.00	.00
BARIUM	2.80	.10	.00	.40
BERYLLIUM	.00	.00	.00	.00
COBALT	.01	.00	.00	.01
MOLYBDENUM	.00	.04	.00	.00
TIN	.00	.00	.00	.00
VANADIUM	.00	.00	.00	.00

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 , WI

SAMPLE NO.	WELL 1	WELL 4 BKG	WELL 2	WELL 3
G4 AND G5 GROUP RESULTS, MG/L				
FLUORIDE	.2600	.4700	.0000	.3100
CYANIDE	<,0050	<.0050	<.0050	<.0050
PHENOLS	.0400	.0400	.0600	.0300
MERCURY	<,0005	<.0005	<.0005	<.0005
ARSENIC	<,0300	<.0300	<.0300	<.0300
CHROMIUM+6	<,0100	<.0100	<.0100	<.0100
SELENIUM	.1000	.1000	.5900	.0300
SULFATE	3,300	20.000	.000	6.600
CALCIUM	240,000	75.000	74.000	240.000
MAGNESIUM	295,000	30.000	36.000	100.000
CHLORIDE	1350,000	180.000	.000	11.000
PHOSPHATE	<,003	.060	.000	<.003
POTASSIUM	32,000	12.000	3.900	28.000
SODIUM	56.000	8.800	4.800	118.000

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 , WI

SAMPLE WELL 1

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <,001

PESTICIDES
<,001

VOLATILES
HEAVY ORGANICS:<,01,LIGHT VOLATILES:<1

REMARKS

PPT NOTED IN PHENOL & CN BOTTLES

SITE ACCEPTED BATTERY WASTE

SAMPLE VERY TURBID

TOTAL WELL DEPTH: 18 FT

DISTANCE FROM DISPOSAL AREA: 70 FT

ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 , WI

SAMPLE WELL 4 BKG

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:<1

REMARKS

PPT NOTED IN CN BOTTLE

SITE ACCEPTED BATTERY WASTE

SAMPLE VERY TURBID

BACKGROUND WELL

TOTAL WELL DEPTH: 44 FT

DISTANCE FROM DISPOSAL AREA: 20 FT

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 , WI

SAMPLE WELL 2

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS:<.01,LIGHT VOLATILES:8.4 & 4.2

REMARKS

PPT NOTED IN CN BOTTLE

SITE ACCEPTED BATTERY WASTE

SAMPLE VERY TURBID

TOTAL WELL DEPTH: 24 FT

DISTANCE FROM DISPOSAL AREA: 230 FT

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ANALYSIS OF WATER SAMPLES FROM

WISCONSIN S-7 , WI

SAMPLE WELL 3

ORGANICS GROUP RESULTS, MG/L

PCBS
ELECTRONEGATIVE COMPOUNDS PRESENT <.001

PESTICIDES
<.001

VOLATILES
HEAVY ORGANICS: <.01,LIGHT VOLATILES:<1

REMARKS

PPT NOTED IN CN & PHENOL BOTTLES

SITE ACCEPTED BATTERY WASTE

SAMPLE VERY TURBID

TOTAL WELL DEPTH: 26 FT

DISTANCE FROM DISPOSAL AREA: 50 FT

APPENDIX B

GLOSSARY

Definitions listed in this glossary are included to help the reader in understanding the description of the project work. They do not represent EPA policy, nor do they have any legal connotation.

Alluvium - A general term for sediments laid down by rivers and streams.

Aquiclude - A saturated but poorly permeable bed, formation, or group of formations that impedes ground-water movement and does not yield water freely to a well or spring. However, an aquiclude may transmit appreciable water to or from adjacent aquifers, and where sufficiently thick, may constitute an important ground-water storage unit.

Aquifer - A geologic formation, group of formations, or part of a formation that is capable of yielding water to a well or spring.

Artesian - The occurrence of ground water under greater than atmospheric pressure.

Artesian (Confined) Aquifer - An aquifer bounded by aquicludes and containing water under artesian conditions.

Artificial Recharge - The addition of water to the ground-water reservoir by activities of man.

Background Well - A well yielding water that most nearly characterizes ambient chemical quality conditions at a particular site.

Base Flow - That portion of stream flow which is composed solely of ground-water discharge.

Bedrock - Any solid rock exposed at the surface of the earth or overlain by unconsolidated material.

Bore Hole - An uncased drilled hole.

Brine - A concentrated solution, especially of chloride salts.

Carbonate - A general term describing the class of sedimentary rocks consisting chiefly of calcium or magnesium carbonate. Such rocks often contain cracks, crevices, and cavities formed by chemical action, which can serve as pathways for ground water.

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Casing - Steel or plastic pipe or tubing that is welded or screwed together and lowered into a bore hole to prevent entry of loose rock, gas, or liquid or to prevent loss of drilling fluid into porous, cavernous, or fractured strata.

Cone of Depression - The depression, approximately conical in shape, that is formed in a water-table or potentiometric surface when water is removed from an aquifer.

Consolidated - A term describing earth materials which have been cohesively bound together as solid rock by natural geologic processes.

Contamination - The degradation of natural water quality as a result of man's activities, to the extent that its usefulness is impaired. There is no implication of any specific limits, since the degree of permissible contamination depends upon the intended end use, or uses, of the water.

Crystalline Rock - An inexact general term for igneous and metamorphic rock as opposed to sedimentary rocks.

Downgradient - In the direction of lower hydraulic head; the direction in which ground water flows.

Drumlins - Gravel hills that were formed by glaciers, have an elongated form, and are generally steepest toward one side.

Dry Well - A bore hole or well that does not extend into the zone of saturation.

Dump - An uncovered land disposal site where solid and/or liquid wastes are deposited with little or no regard for pollution control or aesthetics. Dumps are susceptible to open burning and are exposed to the elements, vectors, and scavengers.

Effluent - A waste liquid discharge from a manufacturing or treatment process, in its natural state, or partially or completely treated, that discharges into the environment.

Electronegative Compounds - See halogenated compounds. These compounds are measured using electron capture detectors in gas chromatography.

Estuarine - Term describing a geologic environment associated with drainage channels adjacent to the sea in which the tide ebbs and flows.

Field Capacity - The moisture content of the soil after water has been removed by deep seepage through the force of gravity. It is the moisture retained largely by capillary forces.

Flow Path - The direction of movement of ground water and any contaminants that may be contained therein, as governed principally by the hydraulic gradient.

Fluvial - Term describing a geologic environment associated with rivers and streams.

Fracture - A break in a rock formation due to structural stresses. Fractures may occur as faults, shears, joints, and planes of fracture cleavage.

Geomorphology - That branch of both physiography and geology which deals with the form of the earth, the general configuration of its surface, and the changes that take place in the evolution of land forms.

Ground Water - Water beneath the land surface in the saturated zone that is under atmospheric or artesian pressure. The water that enters wells and issues from springs.

Ground-Water Reservoir - The earth materials and the intervening open spaces that contain ground water.

Halogenated Compounds - Organic compounds most frequently containing chlorine or bromine as part of the molecular structure.

Hazardous - Any substance or combination of substances which pose a substantial present or potential hazard to human health or living organisms.

Head - The height above a standard datum of the surface of a column of water that can be supported by the static pressure at a given point.

Heavy Metals - Metallic elements, including the transition series, which include many elements required for plant and animal nutrition in trace concentrations, but which become toxic at higher concentrations. Examples are: mercury, chromium, cadmium, and lead.

Heavy Volatile Compounds - Organic compounds with boiling points above 150°C.

Hydraulic Conductivity - The quantity of water that will flow through a unit cross-sectional area of a porous material per unit of time under a hydraulic gradient of 1.00 at a specified temperature.

Hydraulic Gradient - The change in static head per unit of distance along a flow path.

Infiltration - The flow of a liquid through pores or small openings.

Intermittent Stream - A stream which flows only part of the time.

Ion Exchange - Reversible exchange of ions adsorbed on a mineral or synthetic polymer surface with ions in solution in contact with the surface. In the case of clay minerals, polyvalent ions tend to exchange for nonvalent ions.

Kame - A conical hill or short irregular ridge of gravel or sand deposited in contact with glacial ice.

Lacustrine - Term describing a geologic environment associated with lakes.

Lagoon - A waste-water impoundment that receives liquid and/or sludge and may be lined or unlined.

Landfill - A land disposal site located without regard to possible effects on water resources, but which employs intermittent or daily cover to minimize scavenger, aesthetic, vector, and air pollution problems.

Leachate - The liquid that has percolated through solid waste or other man-emplaced medium from which soluble components have been removed.

Light Volatile Compounds - Organic compounds with boiling points below 150°C.

Lithology - The physical character of a rock, generally referred to in terms of a rock type.

Loess - A sediment, commonly nonstratified and unconsolidated, composed of silt-size particles deposited primarily by the wind.

Mineralization - Increases in concentration of one or more constituents as the natural result of contact of ground water with geologic formations.

Monitoring (Observation) Well - A well used to measure groundwater levels and to obtain water samples for water-quality analysis.

Nonpoint Source - The contaminant enters the receiving water in an intermittent and/or diffuse manner.

Organic - Being, containing, or relating to carbon compounds, especially in which hydrogen is attached to carbon, whether derived from living organisms or not; usually distinguished from inorganic or mineral.

Outwash - Sediments deposited by melt-water streams beyond active glacier ice.

Overburden - All material (loose soil, sand, gravel, etc.) that lies above bedrock. In mining, any material, consolidated or unconsolidated, that overlies an ore body, especially deposits mined from the surface by open cuts.

Oxidation - A chemical reaction in which there is an increase in valence resulting from a loss of electrons; in contrast to reduction.

Percolate - The water moving by gravity or hydrostatic pressure through interstices of unsaturated rock or soil.

Percolation - Movement of percolate under gravity or hydrostatic pressure.

Perennial Stream - One which flows continuously. Perennial streams are generally fed in part by ground water.

Permeability - A measure of the capacity of a porous medium to transmit fluid.

Piezometric Surface - The surface defined by the levels to which ground water will rise in tightly cased wells that tap an artesian aquifer.

Plume - A body of contaminated ground water originating from a specific source and influenced by such factors as the local ground-water flow pattern, density of contaminants, and character of the aquifer.

Point Source - Any discernible, confined and discrete conveyance, including but not limited to any pipe, ditch, channel, tunnel, conduit, well, discrete fissure, container, rolling stock, or concentrated animal feeding operation from which contaminants are or may be discharged.

Potentiometric Surface - Used synonymously with piezometric surface.

Public Water Supply - A system in which there is a purveyor and customers; the purveyor may be a private company, a municipality, or other governmental agency.

Recharge - The addition of water to the ground-water system by natural or artificial processes.

Reduction - A chemical reaction in which there is a decrease in valence as a result of gaining of electrons.

Residual Soil - Soil formed in place by the decomposition of the same kind of rock upon which the soil lies.

Runoff - Direct or overland runoff is that portion of rainfall which is not absorbed by soil, evaporated or transpired by plants, but finds its way into streams as surface flow. That portion which is absorbed by soil and later discharged to surface streams is ground-water runoff.

Salt-Water Intrusion - Movement of salty ground water so that it replaces fresh ground water.

Sanitary Landfill - A land disposal site employing an engineered method of disposing of solid wastes on land in a manner that minimizes environmental hazards by spreading the solid wastes in thin layers, compacting the solid wastes to the smallest practical volume and applying and compacting cover material at the end of each operating day.

Saturated Zone - The zone in which interconnected interstices are saturated with water under pressure equal to or greater than atmospheric.

Screened Interval - The section of a well casing which is slotted, perforated, or otherwise open to permit the entrance of ground water into the casing.

Sinkhole - A funnel-shaped depression in the land surface generally in a limestone region which has been developed by solution action.

Sludge - The solid residue resulting from a manufacturing or waste-water treatment process which also produces a liquid stream (effluent).

Solution - The process by which moving water chemically dissolves limestone and other carbonate rocks to form solution channels, sinkholes, and associated features.

Specific Conductance - The ability of a cubic centimetre of water to conduct electricity; varies directly with the amount of ionized minerals in the water.

Strata - Beds or layers of rock.

Surface Resistivity (Electric Resistivity Surveying) - A geophysical prospecting operation in which the relative values of the earth's electrical resistivity are interpreted to define subsurface geologic and hydrologic conditions.

Surface Water - That portion of water that appears on the land surface, i.e., oceans, lakes, rivers.

Till - Nonsorted, nonstratified sediment carried or deposited by a glacier.

Toxicity - The ability of a material to produce injury or disease upon exposure, ingestion, inhalation, or assimilation by a living organism.

Unconsolidated - A term describing earth materials which have not been cohesively bound together as solid rock, such as sand and gravel.

Unsaturated Zone (Zone of Aeration) - Consists of interstices occupied partially by water and partially by air, and is limited above by the land surface and below by the water table.

Upgradient - In the direction of higher hydraulic head (see Downgradient).

Water-Table Aquifer - An aquifer containing water under atmospheric conditions.

Well - An artificial excavation that derives fluid from the interstices of the rocks or soils which it penetrates, except that the term is not applied to ditches or tunnels that lead ground water to the surface by gravity. With respect to the method of construction, wells may be divided into dug wells, bored wells, drilled wells, and driven wells.

Well Capacity - The rate at which a well will yield water.

Withdrawal - The volume of water pumped from a well or wells.

APPENDIX C

PENN ENVIRONMENTAL CONSULTANTS, INC.
QUALITY ASSURANCE PROGRAM

PENN ENVIRONMENTAL CONSULTANTS, INC.
FORT PITT PROFESSIONAL BUILDING
1517 WOODRUFF STREET
PITTSBURGH, PA. 15220
412-381-1133

July 19, 1977

Olin C. Braids, Ph.D.
Geraghty & Miller, Inc.
44 Sintsink Drive East
Port Washington, New York 11050

Dear Dr. Braids:

With respect to your request for information regarding PEC's quality assurance program, I would like to offer the following description of that program.

The basic program includes checking all calibration curves daily, or between every 20 samples, with a standard solution. These checks must be within 10% of the original curve. Duplicate samples are run every ten samples and results must fall within 2 standard deviations. If the above accuracy limits are not met, the corresponding tests on water samples are discarded and repeated. EPA reference samples are run quarterly and results must be within 2 standard deviations.

Monthly control charts are kept for each parameter and filled in daily by the analysts. These charts show the number of samples run, the results of standards, and the results of duplicates. In addition, daily control charts are tabulated. These charts list all the parameters analyzed for each day, results of standards and their % error, and the results of the duplicate samples and their standard deviation.

Monthly control charts record temperatures of all ovens and incubators as checked by a certified NBS thermometer. Analytical balances are checked monthly with class S weights and data recorded. Balances are also serviced annually by a professional service representative.

On a monthly basis, unknown samples are submitted to the laboratory as routine samples without the knowledge of the analyst. Results obtained on these samples are used to assure quality control in the laboratory, and to determine any variance in the methodology or manipulation by an analyst.

Also on a monthly basis, Westinghouse Atomic Bettis submits control samples to us for the analysis of the parameters involved in their testing programs.

Westinghouse Environmental Systems Department submits duplicates along with every group of samples. Normally, these duplicate samples account for approximately 10% to 15% of the total samples. These duplicates are unknown to our analyst. Westinghouse tabulates the data with respect to reproducibility and variance of our analyses.

Penn Environmental Consultants is active in the Cincinnati EPA reference check sample program, and is on the list of analytical laboratories receiving EPA reference samples.

PEC has been working with SCS Engineers of Long Beach, California with a check sample program bid into the contract. Every month, SCS Engineers submits one high and one low check sample prepared by the EPA for verification of PEC data.

Finally, PEC has been asked by the EPA to participate in a round robin involving eleven (11) testing laboratories throughout the United States to determine acceptable methodology for the analysis of leachates. This program is anticipated to start during the next two months and will last for approximately twelve (12) months. Seven (7) governmental agencies and four (4) commercial laboratories are participating in this study.

Olin, I hope you now have sufficient information on Penn Environmental Consultants' Quality Assurance Program. Should you have any questions concerning any of the information, please do not hesitate to call me.

Sincerely,

Richard E. Mazinski
Manager of Analytical Services

REM:ljs

APPENDIX D

CONTRACTOR OBSERVATIONS OUTSIDE THE SCOPE OF WORK

During the course of this investigation, it became apparent that passage over a two-year period of the Safe Drinking Water Act (PL 93-523) and the Resource Conservation and Recovery Act (PL 94-580) has had a major impact on State environmental activities. New hazardous waste legislation has been approved; regulations are being developed to implement State statutes and to promote greater control over land disposal practices; and environmental agencies are being reorganized. This activity is consuming administrative manpower in the majority of States visited. On the technical level, there has been a widespread redistribution of staff responsibilities toward ground-water matters, with reassigned personnel for the most part untrained in ground-water protection requirements. It was also observed that the additional agency workload brought on by new legislation has been imposed at a time when the administrative requirements associated with the Federal Water Pollution Control Act Amendments of 1972 (PL 92-500) continue to require major personnel and budget commitments, for example Section 208 planning.

Six of the States visited are in the process of preparing hazardous waste laws or are formulating regulations required under newly approved legislation. In most cases, promulgation of regulations will take up to 18 months, dependent upon the outcome of required public hearings. Another eight of the States visited have special hazardous waste laws and regulations in effect. The remaining 10 States are operating under old solid waste laws and regulations, not specifically directed at controlling the disposal of hazardous wastes.

Uncertainty associated with what will ultimately be contained in hazardous waste regulations and the shortage of personnel trained in ground-water management did not prevent State officials from fully cooperating throughout the study. Overall, those interviewed are very much aware of the implementation shortcomings of their existing regulations with respect to ground-water protection and felt that correction is possible only through a dramatic increase in staff and funding.

Specifically, there is uncertainty as to which substances to include and exclude from hazardous waste regulation. For instance, many of the constituents classified as hazardous for this study, especially organic compounds, are not listed in drinking water standards nor have health effects been established. This magnifies the difficulty of determining the health implications of some of the contaminants going to the land. Some of the States visited have developed proposed lists of hazardous substances that must be regulated to protect ground water, but health agencies are not certain of the validity of such lists with respect to toxicity.

Generators of hazardous waste and operators of the various disposal sites inspected and sampled were generally cooperative and expressed a need for more guidance with regard to setting specific regulatory parameters for land disposal of hazardous waste. Of particular interest was definition of the types of potentially hazardous wastes amenable to land disposal, and of how such wastes might be disposed of with a minimum effect on the environment. Regulatory agency personnel and site operators expressed frustration at the poor state of the art concerning the ability to predict effects of attenuation processes on the migration of hazardous constituents.

Survey results, backed up by observations of State agency personnel and documentation available in State files, made it apparent that data on landfills is considerably more complete than data for lagoons receiving industrial wastes. The majority of surface impoundments are located within industrial plant sites and receive wastes from one generator. On the other hand, many landfills are on public property and receive a mixture of municipal and industrial wastes from many sources. Thus, landfills are a more visible potential source of contamination. Permitting procedures for siting, management, and closure are generally more rigorous. In addition, State agency officials reported considerable difficulty with inventorying various characteristics of waste lagoons because of the different terms used by many industrial plant engineers to describe impoundments. Confusion exists because of the many processes for which impoundments are used, their great range in size, the intermittent and variable character of the effluent discharged, and the lack of appreciation of the interrelationship between lagoon leakage and potential adverse effects on ground-water quality.

A substantial proportion of hazardous wastes produced in some States of each region is apparently being shipped out of state. Invariably in each region, there are one or two States receiving a major share of the transported industrial waste. In the northeast, some regulatory agencies have the policy of limiting, as much as possible, further disposal of hazardous wastes within their State because of a real or anticipated shortage of disposal sites. This shortage encourages transport of such wastes across State borders in unknown quantities for disposal at inadequately recorded disposal sites. Similar situations occur in other regions of the country as suggested by the inventory and visits to State agencies in the midwest and southeast.

Discussions with regulatory agency personnel regarding siting new facilities for hazardous waste disposal clearly indicate that soil conditions, hydrogeologic factors, and other environmental considerations are being fully considered in the siting of new facilities. However, there is general concern for the ongoing pollution from old abandoned landfills and lagoons, because so many are sited in unfavorable geologic environments, ownership is obscure, and records describing their operation are minimal or lost.

A requirement that the disposer be responsible for long-term monitoring and custodial care of completed landfill sites can be met by special bonding or funds supported by disposers. However, this concept is new and perpetual care of old, abandoned sites typically is undertaken at government expense or becomes the subject of costly litigation to assign responsibilities.

Inspections of abandoned sites revealed that they were neither being monitored nor receiving custodial care.

During the site inventory and inspection phases of this project, documented but unpublished cases of hazardous waste migration in ground water were found in the basic data files of the various State regulatory agencies. These cases did not meet project criteria in that contamination already had been proven. However, the design and operation of the waste disposal facilities involved in the damage cases were similar to project sites finally sampled, where migration of contamination was confirmed. For this reason, a discussion seems merited regarding the type and degree of corrective measures typically employed.

In cases where an aquifer becomes contaminated, corrective measures applied are not always optimum with regard to possible future harm to water supply sources. Typically, the cheapest and fastest solution possible was employed. Such solutions generally involved replacement of affected water supply wells, if an uncontaminated aquifer was available. Where no such aquifer was readily available, an accessible public water supply system was utilized.

In most cases, even when the pollutant was uniquely indicative of only one source, the polluter had to be proved responsible before corrective action could be enforced. In a few others, where the source of contamination was irrefutable, and where public pressure was severe, corrective action was assumed by the polluter without litigation. Aquifer cleanup was seldom considered or performed in the documented cases reviewed during the project. Instead, elimination of the contaminants was left to natural, corrective mechanisms within the affected aquifer, such as attenuation, dilution, and/or eventual discharge to surface-water bodies. This decision was based on the substantial cost of typical ground-water pollution abatement systems and the overall complexity of aquifer cleanup in almost any geologic environment.

Conclusions

Listed below are conclusions in addition to those presented previously in the main body of the report. They are based on information obtained during the study but are outside the contract scope of work.

1. Waste disposal facilities within industrial plant properties represent an especially significant problem because the sites are hidden from public view, have not been subjected to detailed inventory, and are not normally monitored.
2. The use of engineered systems to isolate hazardous substances from ground water at industrial waste land disposal sites is rare.
3. Pollution abatement options as they relate to ground water are complex and costly.
4. The typical solution to contamination of ground water with hazardous substances is to develop an alternative water supply, with minimum effort given to limiting additional pollution of the aquifer or to cleaning up

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the affected resource.

5. Industrial waste disposal sites normally are monitored only to satisfy a specific regulatory requirement.
6. Even in States where monitoring has been required for several years, old sites receiving industrial wastes are still not monitored.
7. Abandoned sites are generally not monitored, and their presence is not usually recorded with the regulatory agency.
8. Records on the source, type, and quantity of industrial wastes received at disposal sites are incomplete, even where regulations call for such records.
9. Dissemination of and action on monitoring data indicating contamination at a particular site is complicated by overlapping responsibilities of State regulatory agencies.
10. Regulation of land disposal of industrial wastes is generally fragmented among a number of State and local agencies with diverse interests, jurisdictions, and objectives.
11. The lack of proper funding of regulatory agencies limits their ability to respond promptly and effectively to ground-water contamination problems.
12. Guidance from Federal, State, and local agencies on the overall approach to industrial waste management as it relates to ground-water protection is still in the formative stage.

13. Those involved in the siting, design, and regulation of industrial waste disposal sites generally are not trained in the practical application of techniques to protect ground-water quality.

14. The lack of a clear definition of hazardous wastes and the absence of standards for establishing thresholds of toxicity are limiting the ability to protect ground water from contamination by land disposal of industrial wastes.

15. Many legal definitions and interpretations of ground water, water table, and aquifers, as related to the siting and monitoring of waste disposal sites, do not conform to principles of ground-water occurrence, movement, and susceptibility to pollution.

16. Regulations that consider ground water and surface water as a single resource are generally the most successful in protecting the environment against poor land disposal practices.

17. Inventorying and permitting lagoons and other liquid waste disposal facilities lag behind such efforts directed towards landfills.

18. Some States, because of their inability to enforce regulations, are receiving unknown quantities and types of industrial waste from other States.

19. The outstanding cooperation received during this study from State and local regulatory agency personnel demonstrates a widespread interest in minimizing future adverse effects from land disposal of hazardous wastes.